25th ANNIVERSARY NUMBER

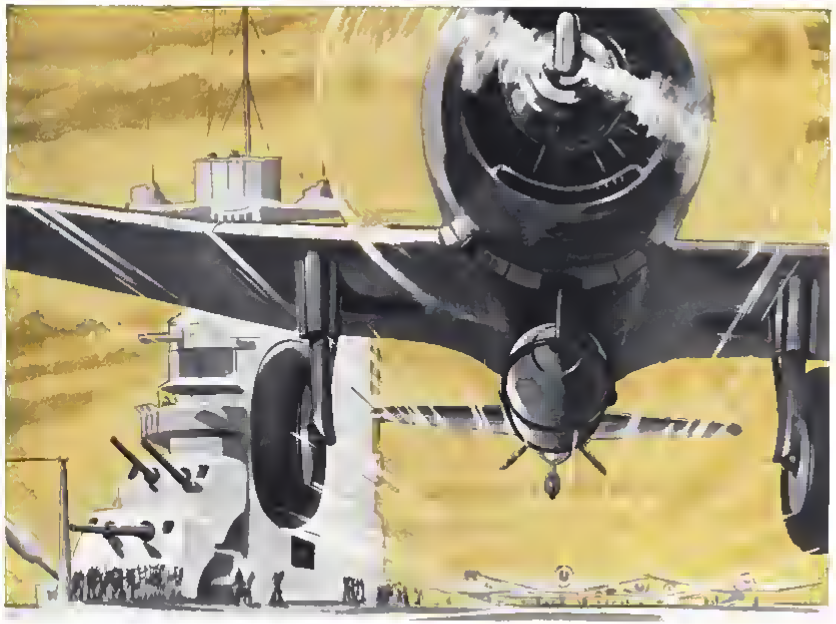
AUG. 1941

AVIATION

The Oldest American Aeronautical Magazine

McGraw-Hill Publishing Company, Inc.

Price 50c. per copy



No spot for a Motor to Conk

● When aircraft engines start lifting a land plane off the deck of a carrier there can't be any "let down" in engine power. A plane can bounce safely a couple of times in a ground take-off but there is no bounce to the ocean. And when a plane, with heavy bombs hanging below its belly, lifts clear of a solid deck, it's a comfortable feeling to see it stay clear.

Engine power depends largely on valve efficiency. A burned, warped, or sticking valve seriously impairs power output. The exhaust valve in an aircraft engine must withstand the white heat of constant explosions, while it holds true and seats accurately under trip-hammer battering.

When Thompson Products developed the heat resisting Silchrome steel valve in 1922, it opened new horizons for aircraft engine speed and reliability. Today Thompson Products manufactures the famous sodium-cooled exhaust valve for ignition—a vital part of complex steel tubes of low head and stem partly filled with sodium. Engine heat melts the sodium. The liquid rapidly dissipates the heat in cooling the valve. On its seat and stem tip points of hardest wear, the valve is trimmed with super-hard Stellite.

The Thompson Sodium-Cooled Valve is but one of many aircraft engine and airplane parts built by Thompson. Six thousand Thompson Products workers are engaged in producing these high precision parts at top speed.

THOMPSON PRODUCTS, INC
Cleveland • Detroit • Toledo • Los Angeles • St. Catharines, Ontario

Manufacturers of over 1000 different aircraft engine and airplane parts, and original and replacement parts for the automotive industry. A pioneer of the sodium cooled aircraft engine valve.

Thompson Products

PIPER POINTS THE WAY WITH ...A PLANE TO FULFILL YOUR EVERY FLIGHT REQUIREMENT

Piper is the plane for the people of America! On the U. S. Civilian Pilot Training Program, where thousands of pilots are being trained for national defense, Piper planes outnumber all other makes combined by more than 3 00 to 1. In addition, men and women of all ages are finding their wings in these dependable, economical ships over every section of the country. And no wonder, for only Piper offers you a *complete* line from which to choose — a plane for every purpose. The famous Piper Cub tandem trainer is priced as low as $995, the roomy, three-place Piper Cruiser is but $2150 and the luxurious Piper Coupe is $2575 (all prices F. A. F. Lock Haven, Pennsylvania.)

FREE FLYING COURSE
in his own plane is offered the purchaser of a new Piper. It consists of eight hours of dual flight instruction — take-offs, landings, taxiing and fundamental air maneuvers. At the completion of this free course the average person is ready to solo.

FREE FOLDER showing all the new Piper planes will be sent you on request or may be obtained from your Piper Dealer. Or, if you wish a copy of the new Piper deluxe, full-color, 36-page catalog, it will be gladly mailed you, providing you enclose 10c in stamps or coin for postage handling. Piper Aircraft Corporation, Dept. AH, Lock Haven, Penna.

DOWN PAYMENT PRICES START AT

$333

EASY MONTHLY INSTALLMENTS

PIPER OUTSELLS ALL OTHER LIGHT PLANES COMBINED

Tune in "Wings of Destiny" NBC Every Friday 10 P. M. (E. D. S. T.)
Continental "65" Piper Cub Given Away Each Week

Published monthly, price 5% a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—United States, Mexico and Central American countries $3.00 a year, $4.00 for two years, $5.00 for three years. Canada $3.50 for one year. Great Britain and British Possessions 30 shillings per year, 50 shillings for three years, all other countries $4.00 a year, $10.00 for three years. Entered as second class matter September 8, 1939, at the Post Office, Albany, N. Y., under the Act of March 3, 1879. Volume 16, Number 8

The Birdmen's Perch

We're old friends, so I suppose we can speak frankly. Now honestly, fellows, was last month's problem too tough for you? Are you ready to cry "Uncle"? If you are, just write and let me know—we'll go back to easy "Brain-Twisters" again.

Major Al Williams, alias "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

FUNNYBONER DEPT.

The following Aviation Primer was authored by Russ Brinkley of Station WHP, Harrisburg, Pa. Not bad, Russ!

Q: What is a wing flap?
A: An aileron on relief.

Q: Describe a successful landing.
A: Any landing you can walk away from.

Q: What is the last word in parachutes?
A: Jump!

Q: Define an amphibian.
A: A combination eagle, chicken, and duck.

Q: What is aeronautical amnesia?
A: Instrument flying.

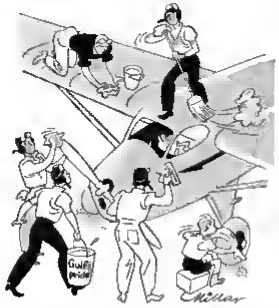
THIS MONTH'S BRAIN TWISTER

Clifford Crankshaw of Detroit, Mich., sends in this "brain blitz," as he calls it, for you to work on:

An air taxi operator paid $90,000 for a fleet of planes, each costing the same amount. Five of the planes crashed and he sold 20% of the remainder for one-sixth of his original investment.

How many planes did he buy and how much did he pay for each?

FLYING HOUSEKEEPERS



The other day we dropped off at the airport at Hartford, Conn. It was one of those bright spring days—perfect for flying—that really bring the sports pilots out.

We lay there on the grass, watching them as they practiced take-offs and landings and suddenly we were struck by the fact that every plane seemed as spic and span as though it had just come off the assembly line. And then looking over at the hangar where most of the pilots kept their planes, we saw—a great big GULF sign!

What's the moral? Simply this. A pilot who takes pride in the appearance and condition of his plane, thinks about the *inside* as well as the outside. These pilots were mostly Gulfpride users. Because they know that one of the best ways to keep an engine clean and sweet-running is to use an oil that has been specially refined so as to be resistant to carbon and sludge formations. They know that Gulfpride is refined from *special crudes*—by our special Alchlor Process—a process which removes *more* of the engine fouling carbon and sludge formers.

Of course you take pride in your plane. And *we* take a great deal of pride in being able to produce an oil like Gulfpride for pilots like you!

THIS MONTH'S WHOPPER

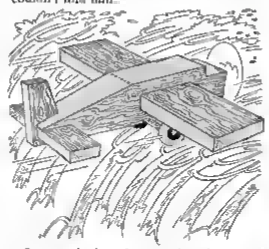
Dear Major:

It happened in the banana country of Panama. His name was Wilbur (deleted by censor.)

When I wandered through the jungle into his home, he was testing his second plane. He even had a home-made field. The runway was carefully graded—6 feet wide by 100 feet long and 150 foot jungle trees right up to the edge.

Since the termites were bad, he constructed this ship from the tropical wood, Copoholo, which is impervious to insects and about twice as heavy as lead. To start with, the fuselage used four by fours with four by four braces. This was covered with 1 inch planking (all toe-nailed in). The controls took bailing wire, while the joy stick was carved out of a piece of Copoholo that I could not reach around with both hands. He had a French Monoseupapa motor for power, about 80.

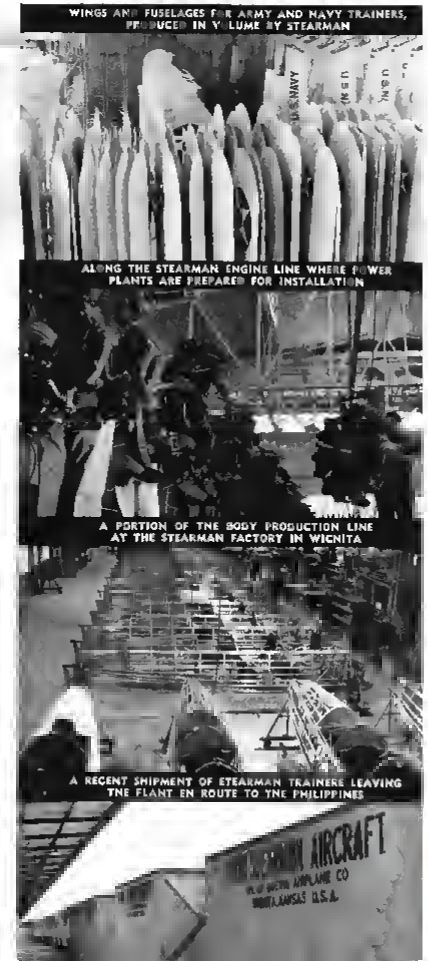
I slipped a gallon of Gulf Aviation Gasoline into his kerosene tank, and watched him take off. He went through those trees so fast that they fell right back on their trunks! He was headed toward a big ditch at (0) degrees altitude. I heard the next day that the government was going to pay him for digging the new locks for the Panama Canal, but they couldn't find him.



Six months later he turned up in a monastery in the Khyber Pass, chewing a lead pencil and saying over and over... I would've went further but that G.A.G. was so strong all the cylinder heads blew off and I got tired sticking my hands over each piston in the firing order.

Yours truly,
Kenneth W. Byars,
Ex USN '43

AMERICA LOOKS TO STEARMAN FOR MASS TRAINER PRODUCTION



In quantity, as in quality, Stearman leads the industry in primary trainer production. During recent expansion, more than 1,000 planes were produced in record time. Now, with floor space tripled in the main plant, output is increased many fold. The continued confidence of the United States Army and Navy is expressed in recent large orders. Stearman Trainers are also being delivered in quantity to the Philippines and South American countries.

Safety, reliability and advanced engineering are factors that have won for Stearman Trainers their prominence in the field of military flying instruction.

STEARMAN AIRCRAFT DIVISION
Wichita, Kans.

Boeing

BOEING AIRCRAFT COMPANY
Seattle, Wash.

STEARMAN TRAINERS

The Nation's Pilots are being Trained behind

LYCOMING AIRCRAFT ENGINES

BOMBER, interceptor, pursuit or trainer, every airplane's heart is its engine. Reliable power is most important when pilot skill is being taught and acquired in the training plane. And that is where the Lycoming engine's long-established reputation for unfaltering dependability has won favor of both military and civilian flight instructors throughout the nation.

Economical Lycoming engines predominate in the light-plane trainers used in the Civilian Pilot Training Program. More powerful Lycoming radial engines fly the Stearman and Spartan trainers employed by the Army and Navy for flight instruction. These smooth-operating power plants are likewise found in the new Stinson liaison and observation plane and in the bi-motored Beechcrafts, Cessnas and Curtiss-Wrights used by the Army Air Corps to acquaint its pilots with multi-engine operation. Lycoming leadership in America's training planes is an established fact predicated upon safety, economy and comfort . . . a fact important to all who fly.

FREE LITERATURE

on Lycoming 50 to 75 horsepower horizontally opposed light plane engines. Lycoming 100 to 175 horsepower horizontally opposed engines or Lycoming 220 to 300-horsepower radial engines. Please specify which literature you wish. Lycoming Division, Dept. A81, Aviation Manufacturing Corp., Williamsport, Penna., U. S. A. Cable address: Aviatcor.

Contractors to the U. S. Army and Navy

LYCOMING HORIZONTALLY OPPOSED ENGINES are available in four-cylinder 50, 55, 65, 75, 100 and 125 horsepower and six-cylinder 150 and 175 horsepower. All are air cooled and have provision for either mechanical or electric starter and accessory drives.

LYCOMING RADIAL ENGINES are manufactured in 220, 280, 290 and 300 horsepower. All are nine-cylinder, direct drive and air-cooled with provision for starter, generator, fuel pump, vacuum pump, dual tachometer drives and hydro propeller control.

FOR MILITARY AND CIVILIAN TRAINERS ★ FOR PRIVATE AND COMMERCIAL USE

SPARTAN ... AVIATION INDUSTRY...

Keeps Pace with the ...With Modern Training Facilities Representing an Investment of $2,000,000.00

Aircraft Sheet Metal mechanics training is based on actual experience.

(Above) Learn to fly in latest type training planes

(Above) Instrument Department has $30,000 worth of new equipment

★ Down through the years since its inception in 1928 SPARTAN has kept in step with aviation progress. As this great American industry has rapidly advanced to its present dominant position, SPARTAN has also advanced in its training facilities and aviation courses. Today SPARTAN is recognized as one of the country's most modern and progressive aviation schools.

SPARTAN'S new buildings, new equipment, new training planes, new technical courses and other extensive facilities represent an investment of *two million dollars!* School buildings provide a total floor space of 588,387 sq. ft. (over 10 acres). A $750,000 expansion program continues to push this progressive school ahead with leaps and bounds. Consider these FACTS:

★ SPARTAN has at Tulsa alone 24 buildings including 300 x 125 shop building 190 x 51 engineering building 5 giant hangers medical building, cafeteria seating 1200 persons 10 dormitories comfortably housing 800 students, student forum building, student store and barber shop, plant maintenance building 8-engine test house.

★ SPARTAN has 35 modern training planes in use by the Civil school . . . six flying fields . . . 560 employees.

★ SPARTAN's 100% Approved Repair Station has facilities for servicing 325 planes now used in Civil and Military flight instruction plus 48 modern engines used for student instruction including fourteen 1000 h.p. twin row engines.

★ SPARTAN has the following shops: engine overhaul, airplane overhaul, wood shop, propeller shop, instrument, sheet metal welding, parachute, engine testing, electrical, radio, paint and dope shop.

★ SPARTAN laboratories include: instrument, meteorology, navigation, fuels and oils, hydraulics and deicing, physics, metallurgy.

★ New $15,000,000 bomber assembly plant expected to employ 15,000 persons is now under construction adjacent to SPARTAN.

★ SPARTAN is receiving calls for more graduates than can be supplied. SPARTAN flight graduates are getting immediate employment at $175 to $250 a month—and SPARTAN could place an unlimited number of graduates for practically all other positions in aviation.

★ SPARTAN is located in the heart of America's greatest flying country.

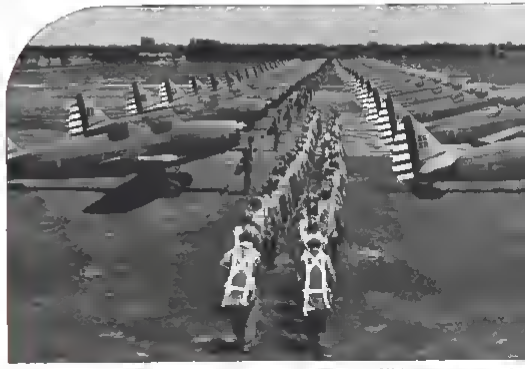
SPARTAN In National Defense

★ SPARTAN is recognized not only for the important part it plays in commercial aviation by turning out unexcelled trained men to meet the demands of the industry, but also for its prominent part in national defense. With its extensive facilities at three separate locations—Tulsa, Muskogee and Miami, Oklahoma—SPARTAN is participating in the vital U. S. Army Air Corps training program. SPARTAN was awarded the training of Air Corps Flying Cadets and Enlisted Men because it was considered so well organized, so experienced and so favorably located.

SPARTAN is also building planes for the U. S. Navy, the SPARTAN factory having recently been doubled in size in order to take care of Navy contract orders. This factory is directly connected with the school and offers quick employment to many graduates.

★ Yes, SPARTAN is a big school, a great school, Government Approved and industry recognized, *but not too big to assure you skilled personalized instruction.* Whatever field of aviation you choose to enter—Sheet Metal, Aircraft or Engine Mechanics, Flight, Engineering, Radio, Instrument Mechanics, Meteorology—you reap tremendous advantages from SPARTAN'S superior facilities.

(Above) Spartan Air Corps Fleet at Tulsa Oklahoma



(Above) Spartan Air Corps Fleet at Muskogee Oklahoma

(Below) SPARTAN is a city within itself with every facility for unexcelled training and pleasant living

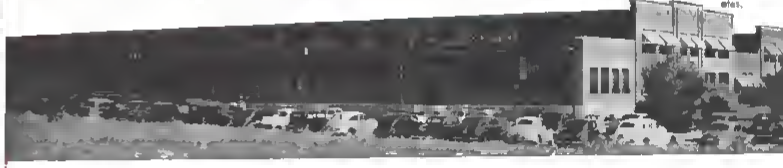
SPARTAN SCHOOL OF AERONAUTICS
DIVISION OF SPARTAN AIRCRAFT COMPANY

(Below) Meteorology Department is modern in every respect

(Below) Equipment valued at $16,000 keeps Radio Department abreast of the times

MAIL COUPON for FREE CATALOG—Get your personal copy

of the new SPARTAN Catalog giving complete information about the school its facilities and training courses. No salesmen will call on you. The catalog tells all the story. *(Next Semester Starts September 29th)*



SPARTAN SCHOOL OF AERONAUTICS—Captain Maxwell W. Balfour, Director
Address Dept. A-81 e, Tulsa, Oklahoma

Send me your new Catalog describing in detail the SPARTAN courses I have checked also stating tuition and living expenses.

Name _____ Age _____

Address _____

City _____ State _____

CHECK COURSES YOU PREFER

- ☐ Commercial Pilot
- ☐ Air Transport Pilot
- ☐ Commercial Flight Instructor
- ☐ Air Transport Engineering
- ☐ Aeronautical Engineering
- ☐ Aircraft Sheet Metal
- ☐ Airline Service Mechanic
- ☐ Aircraft or Engine Mechanic
- ☐ Radio Maintenance and Operation
- ☐ Private Pilot Co
- ☐ Weather Forecas
- ☐ Instrument Technician

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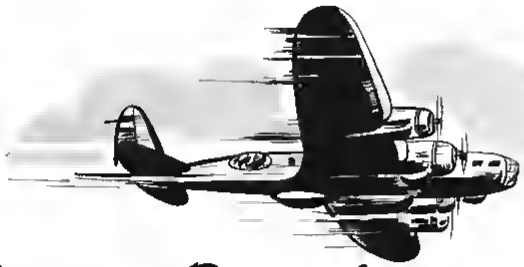

Playing a Part in America's Air Strength

25 YEARS OF FLYING PROGRESS

Hearty congratulations to those farsighted men who have built Aviation to one of America's great industries in such a short space of time. We are happy to have been able to serve the needs for quality castings during these last twenty-five years. Our policy is based primarily on quality. We shall stick to this policy. Our products are accepted; we have kept abreast of developments and technological improvements; we shall continue to do so.

Our leadership in the improvement of foundry practice, our years of experience under a wide variety of conditions enable us to meet every demand for sand and permanent mold aluminum casting. Alloys produced in accordance with Army, Navy, S.A.E. and A.S.T.M. specifications.

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THE *National* BRONZE & ALUMINUM FOUNDRY CO.

E. 88th and LAISY AVE. *"Pioneers In Aluminum Castings"* CLEVELAND, OHIO

BARBED WIRE AND ARMED GUARDS DON'T PROTECT AGAINST CORROSION . . .

PROTEK-SORB Silica Gel eliminates the corrosion hazard . . . speeds up plane assembly. Fulfilling Uncle Sam's demands for "MORE PLANES" has shown the value of Protek-Sorb Silica Gel to the aircraft industry. For now it is possible to store and ship vital engine parts, complete engines and planes, without using costly, time-wasting slushing compaunds. The proper use of Protek-Sorb has saved the industry millions of dollors by preventing corrosion damage, ships are being assembled faster; many man-hours are saved on each plane, operations have been improved.

THE CHANDLER-EVANS PROTEK-PLUG USES PROTEK-SORB

This Protek Plug is designed to prevent corrosion in cylinder barrels etc., while engine is in storage or shipment. One example of the adaptability of Protek-Sorb to the industry.

Every industry related to or supplying the aircraft industry needs the protection that Protek-Sorb offers. Write the Davison Chemical Corporation, Baltimore, Md., for full information about how to use Protek-Sorb effectively. If you have a corrosion problem—let our research and engineering department solve it.

use PROTEK-SORB Silica Gel . . . then Forget about corrosion!

Protek-Sorb SILICA GEL

Is a Product of

THE DAVISON CHEMICAL CORPORATION *Silica Gel Dept.* BALTIMORE, MD.

30 YEARS WITH CESSNA

5 YEARS BEFORE AVIATION

on April 16, 1911, the first CESSNA airplane made its maiden flight at Enid, Oklahoma. That flight was more than a successful demonstration, it was the first long step in an era of engineering progress that has contributed much to the science of present day aviation

Today the clean, trim lines of CESSNA Cantilever construction are recognized throughout the civilized world in commercial and military craft. These CESSNA Planes have established a reputation for safety, performance, dependability and economy under all conditions. They have achieved this enviable position because 30 years of knowledge, skill and experience have been devoted to refinement and development of a fundamentally sound design

CESSNA pledges its entire facilities to continued development of those qualities which have won for it designation as "The World's Most Efficient Airplane."

LET'S GO! U.S.A. KEEP 'EM FLYING!

CESSNA T 50 Twin—Variations of this model are being used by the U. S. Army and the Royal Canadian Air Force

The CESSNA Airmaster A 4 passenger cabin monoplane that offers more in performance economy and safety

The Bulreit News Trophy won three times in competition and now permanently Cessna's. Through this triple award CESSNA is officially recognized as The World's Most Efficient Airplane

THE WORLD'S MOST EFFICIENT AIRPLANE

CESSNA AIRCRAFT COMPANY

CONTRACTORS TO THE U. S. ARMY AND THE ROYAL CANADIAN AIR FORCE

WICHITA, KANSAS, U.S.A.

BALL BEARING DO'S AND DON'TS FOR MECHANICS

"WHY DONTCHA STORE 'EM IN THE COALPILE?" SCREAMS GUS

Boy, was Gus sore! He saw Joe Snaffle handing a mechanic some "new" ball bearings from stock, and they weren't even in their boxes. You couldn't see a speck of dirt on 'em, but Gus is heck on keeping ball bearings clean. He says, "I reckon I'll get a buncha stevedores to run the stockroom . ."

GUS SAYS "DON'T"

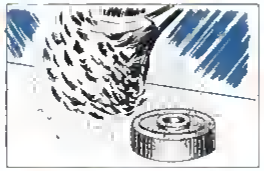
DON'T remove bearings from original packages until ready to use.

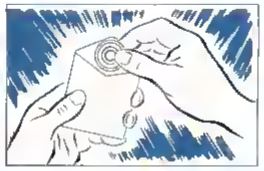
DON'T wash lubricant out of engine control bearings when you wash down the firewall.

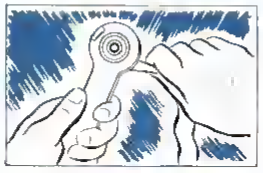
DON'T attempt to clean or grease new ball bearings – the maker's already done this job for you.

Handling In Stock

First of a series of instruction sheets published by The Fafnir Bearing Company, based on ten years' experience with the leaders of U. S. aviation.







STORE BEARINGS in a cool dry place to cut down deterioration or aging of lubricant. CLEAN BINS before you put bearing boxes into them, and clean them once a month thereafter. Keep old stock to the front so it will be used first.

DON'T ISSUE bearings to mechanics until sure they're actually ready for them. Drop a hint about not opening or unwrapping them until mounting preparations are complete. There's enough dust in the air to ruin an unshielded bearing.

IF PACKAGE in which bearing was delivered becomes lost, don't put unprotected bearing back in stock. Use paper envelopes to cover them. For further protection it is recommended that unwrapped bearings be stored in screw top glass jars.

WHEN ACCESSORY parts are returned to stock after assembly, be sure area near bearings is clean, then cover bearings with tape. This will protect them until part is ready for final assembly.

ANY QUESTIONS you have about ball bearing handling or application will be answered gladly by our specialized aircraft ball bearing engineers. Write The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

We Started with the WRIGHT BROTHERS

THE Marvel-Schebler Carbureter Division of the Borg-Warner Corporation is a combination of the two oldest carbureter manufacturers in the United States.

At the present time the Marvel-Schebler Carbureter Division is supplying carbureters as standard equipment on a great percentage of the present production of the light aircraft engines. The manufacturers using these carbureters as standard equipment include such as Franklin Aircooled, Lycoming, and Continental.

The aviation activity of the Marvel-Schebler Carbureter Division dates back to the infancy of the aviation industry. Beginning in 1900, the Wheeler-Schebler Carbureter Company was formed by Mr. George M. Schebler and Mr. Frank H. Wheeler in the manufacture of a very simplified carbureter, known as the Schebler Model D, and was designed primarily for small motorboat and stationary engines. At that time, this carbureter was made of brass.

Not long after this, Wilbur and Orville Wright were developing their heavier than air flying machine, and were much interested in a carbureter of the finest quality. Because of the factor of weight, they wanted one made of aluminum, so at that time, the Model D carbureter was designed and cast of aluminum for the Wright Brothers use, and was used almost entirely on the early experimental models of their "Petrol" aeroplanes. After the experimental flights with gliding machines at Kitty Hawk, North Carolina, the first successful flight of any great distance (24 miles at a speed of approximately 38 miles per hour) was made near Dayton, Ohio, on October 5, 1905. The Model D Schebler carbureter was a part of the equipment. Through several succeeding years, this carbureter was used as standard equipment on the Wright Brothers aeroplanes.

It is interesting to note that this carbureter was of very simplified construction, being a fuel bowl with a single main nozzle and an air inlet casting with a valve and adjustable spring. It is also interesting that this same carbureter is being manufactured today for certain classes of internal combustion engines, and is the only type carbureter that has survived the further developments of this type of engine.

A few years later, it was necessary to have a more flexible carbureter for internal combustion engine use, and at that time the Model L Schebler carbureter was developed and used on the Wright aeroplanes. At about this same time there were other developments in the aviation field, and a new company came into existence, the Glenn L. Curtiss Company, who started to manufacture a "pusher type" aeroplane, and the Model L Schebler carbureter was standard equipment on this aeroplane, beginning in 1909.

It is extremely interesting to compare these old crude types of carbureters with the present streamlined construction, with the automatic fuel and air controls for the great flexibility required in the present day engines.

The new Model MA Marvel-Schebler light aircraft engine carbureter is capable of delivering the varied air fuel ratios required for flexible operation in the present-day engines, without the aid of mechanically operated parts. These different air fuel mixtures are controlled by throttle opening and relative intake manifold vacuum, accomplished by what is known as back suction economizer control.

Other features available in the new Model MA Marvel-Schebler carbureter are:

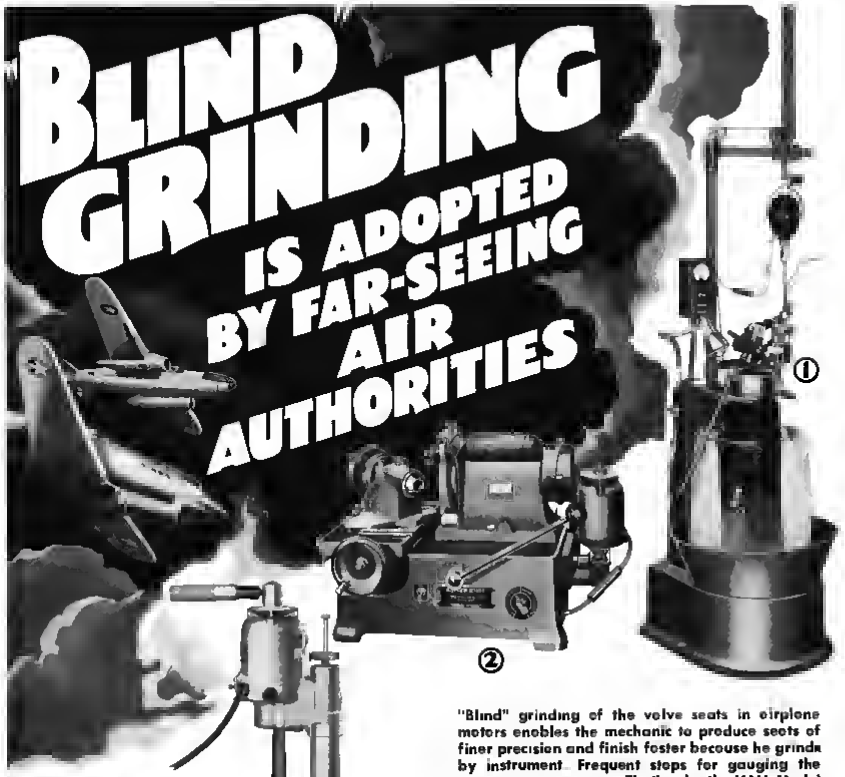
1. Accelerating pump
2. Manual or automatic altitude control for better performance and economy in flight
3. Double float, providing accurate fuel metering in extreme angles of flight.
4. Double venturi mixing chamber for improved mixture distribution
5. Stainless steel throttle bushings, to prevent throttle sticking and excessive wear
6. Simplified fuel passages, to prevent vapor locking of high test gasolines in the carbureter channels

MARVEL-SCHEBLER CARBURETER DIVISION

BORG-WARNER CORPORATION

Flint, Michigan

BLIND GRINDING IS ADOPTED BY FAR-SEEING AIR AUTHORITIES



① The Model AW Wet Type ECCENTRIC Grinder is available in both production and service types.

② The HALL Model 80A Wet Type Valve Refacer produces a valve face of a precision and finish that duplicates original factory standards.

③ Hundreds of HALL Model EJA ECCENTRIC Grinders are in use in servicing valve seats in Rolls-Royce and other in-line type motors.

"Blind" grinding of the valve seats in airplane motors enables the mechanic to produce seats of finer precision and finish faster because he grinds by instrument. Frequent stops for gauging the seats are unnecessary. That's why the HALL Model AW ECCENTRIC Valve Seat Grinder has been so widely adopted by those responsible for speeding up production and maintenance.

Other types of HALL ECCENTRIC Valve Seat Grinders and the HALL Wet Type Valve Refacer with rheostat control enable the maintenance shop to duplicate original production standards of precision and finish and with a speed that gets motors back in service quicker.

Catalog of HALL Grinders and description of HALL ECCENTRIC grinding awaits your request.

THE HALL MANUFACTURING CO.
TOLEDO, OHIO, U.S.A.

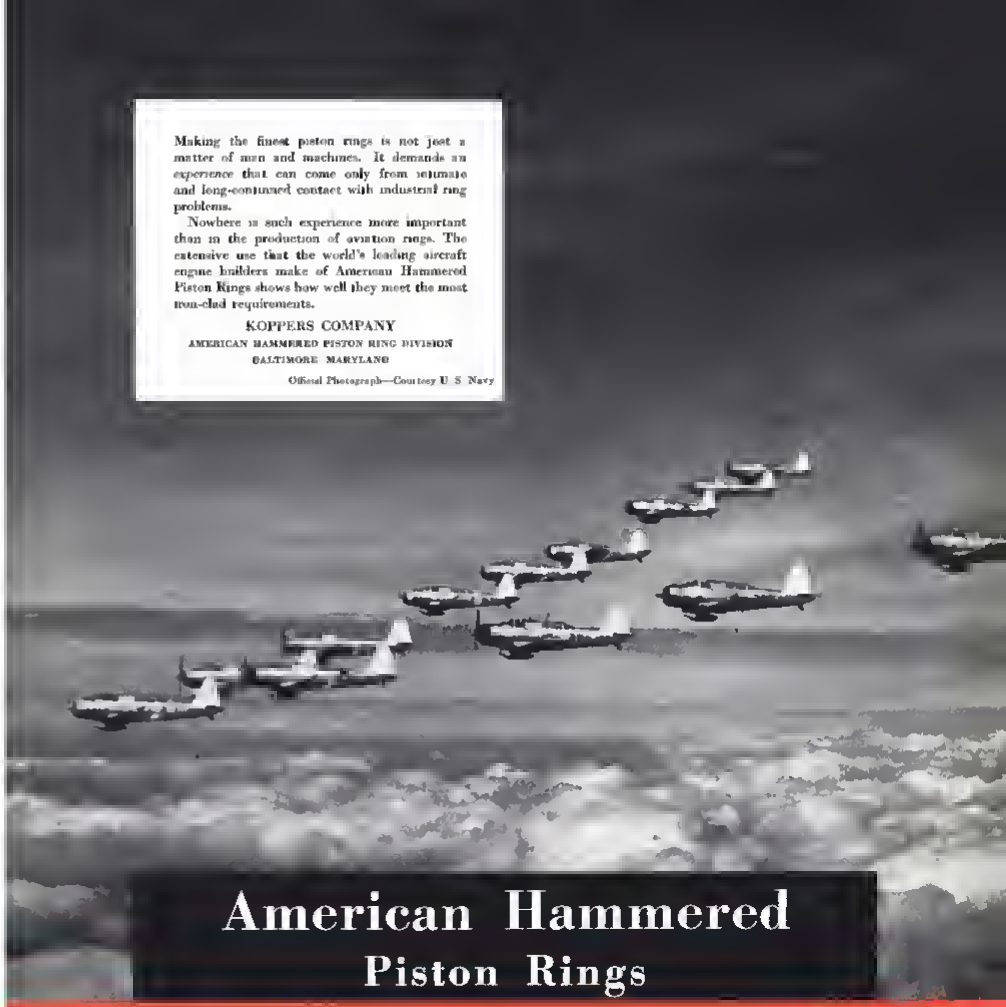
HALL ECCENTRIC SEAT GRINDERS

Making the finest piston rings is not just a matter of men and machines. It demands an experience that can come only from intimate and long-continued contact with industrial ring problems.

Nowhere is such experience more important than in the production of aviation rings. The extensive use that the world's leading aircraft engine builders make of American Hammered Piston Rings shows how well they meet the most iron-clad requirements.

KOPPERS COMPANY
AMERICAN HAMMERED PISTON RING DIVISION
BALTIMORE, MARYLAND

Official Photograph—Courtesy U. S. Navy



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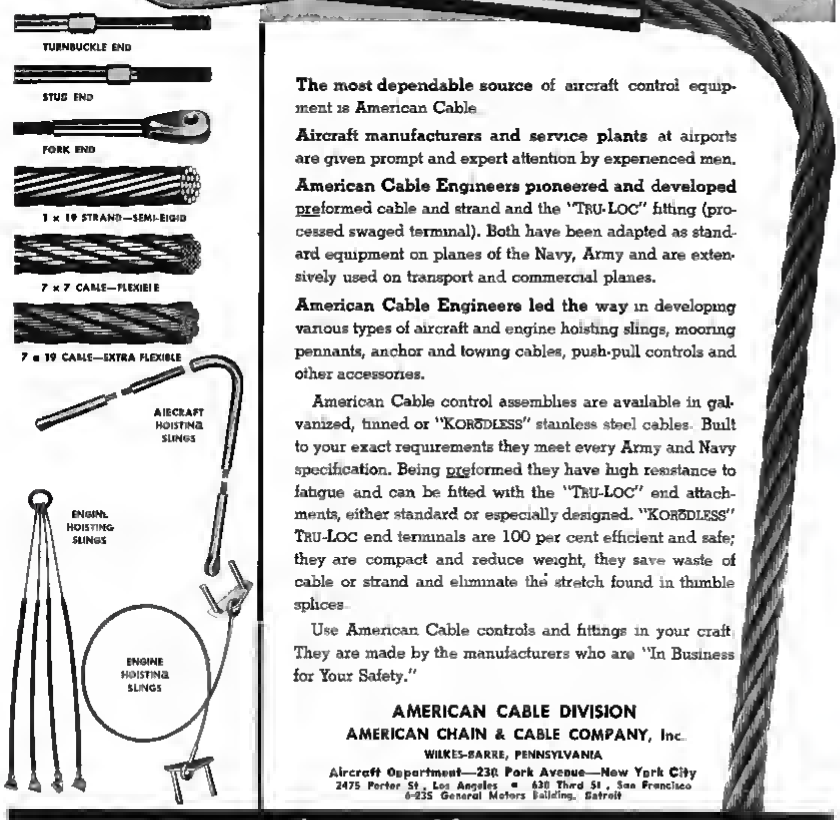
AIRCRAFT CONTROL EQUIPMENT



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C-D laboratory research is not a product of the present emergency — this service was established and used extensively by our customers as early as 1914—today it offers you a wealth of experience gained in solving thousands of material problems. Use it as though it were a division of your own company.

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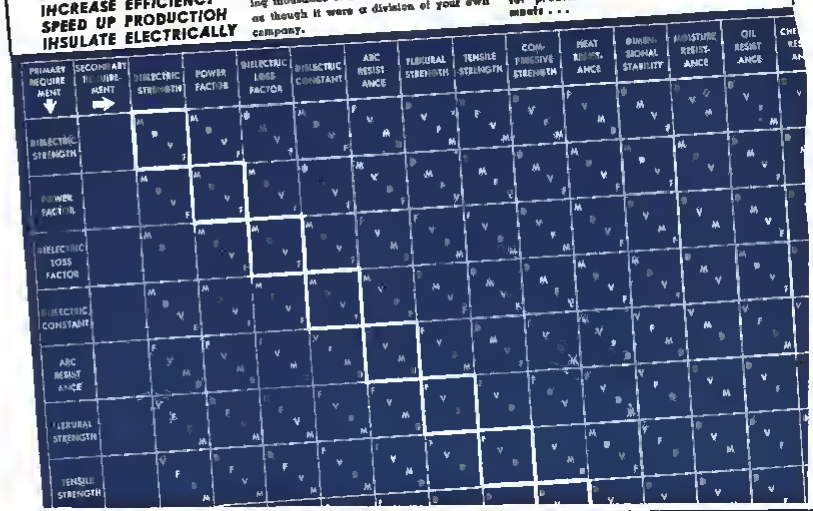
F for Vulcoaized Fibre . . . V for Valcoid
THEY ARE ARRANGED FROM UPPER LEFT TO LOWER RIGHT in order of their suitability for problems involving two known requirements . . .



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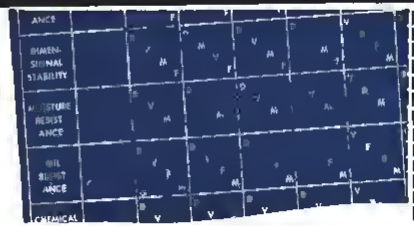

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Send me the 20" x 26" wall chart on C-D non-metallic materials and the booklet "What Material?"

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5

ALUMINUM, DEFENSE, AND YOU

GENTLEMEN, BEHOLD A PARADOX!

ONE POUND OF CIVILIAN ALUMINUM becomes one pound of Defense Aluminum by the simple process of writing the magic symbols AA to A-10 on certain pieces of paper.

THIS DEFENSE ALUMINUM we are making is not special aluminum, it is just good old Alcoa Aluminum in especially *large* quantities

HOW LARGE? Each pound of civilian aluminum shipped in the average month of 1930-38 has been multiplied into almost four pounds a month for defense. And this was possible only because we started to spend over $200,000,000 for expansion long before today's needs became generally recognized.

The 2400 foot long rolling mill being constructed at Alcoa, Tennessee. This new 57 acre plant will bring our sheet rolling capacity up to more than 33,000,000 pounds per month.

HERE'S THE PARADOX. Civilian Aluminum is exactly what we are making. Defense Aluminum is what we are shipping—and a great deal of it.

DEFENSE DOES NOT ASK FOR different aluminum. It could not ask for better aluminum. It asks only more of the same. We are happy to report that defense industries asked for and got from us something like twenty million pounds *more* last month than were forecast in schedules set up six months ago.

DEFENSE ORDERS specify aluminum in the old familiar way, using the same train of tried and true Alcoa Alloy numbers—2S-3S-11S-17S-24S 52S-195-356, and all the rest. They do the same things superlatively well, for Defense, that they have been doing for you

WHEN ALUMINUM COMES BACK into civilian use, it is going to be very like switching this crack train of Alloys of Alcoa Aluminum right back on your track.

BUT THERE WILL BE SOME SURPRISES aboard. New techniques, new economies, are being sought, found, and already put into use by our busier-than-ever researchers. Probably there will be a new alloy or two. Certainly, there will be many new ways to use the old ones, profitably.

ALUMINUM COMPANY OF AMERICA

The Bendix designed amplifier illustrated in the large photo above represents the heart of this Interphone Equipment. Connected with this lightweight unit are individual Station Boxes for each member of the crew. The resulting system provides complete intercommunication between any combination of crew members at any point in the airplane.

LITERALLY thousands of Bendix Aviation, Ltd., Interphone Communication Systems are being installed in American warplanes under contract to the Royal Air Force. Because of its exclusive service facilities this entire job has been turned over to Bendix—to design—custom-build—and install.

The systems provide complete intercommunication between members of the crew and this has made teamwork a routine matter accomplished without handicap. The equipment has already been engineered into eleven different types of British military aircraft.

Bendix Aviation Ltd., alone offers this all-inclusive radio development service which assumes full responsibility for the design and satisfactory installation of radio equipment. Bendix invites inquiries regarding your own radio problems, whatever functions must be accomplished.

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THE *Lockheed* LOG

LEADERSHIP

IN PUBLIC ACCEPTANCE

Lockheed has millions of the shrewdest, smartest customers in the world today! They're the kind of customers who know a good buy when they see it...and when it comes to airplanes for defense, they want the best! These important customers are the citizens of the world's democracies.

SINCE its very beginning Lockheed has had the confidence of aviation minded pioneers in all countries. It has built dependable transports so that everyone might travel in speed and luxury...*and they have been accepted* It has produced executive airplanes to facilitate business transactions...*and they have been accepted.* And it has kept the world abreast of every new development through a consistent, informative advertising program.

Now, when factories have become huge to accommodate military orders...and free people everywhere have a vital interest in their program of defense...Lockheed feels its obligation more strongly than ever. It must continue to deliver airplanes that are better and better...it must continue its research and development program to stay ahead of the fast moving aviation field and, exclusive of military secrets, it will always wish to keep these important customers informed of the progress of aviation in both industry and defense.

For it is the belief in this progress that sustains the will to win...that assures the continued acceptance of Lockheed products. And it is only world wide public acceptance of this kind that can assure the continued employment of 33,000 skilled Lockheed craftsmen.

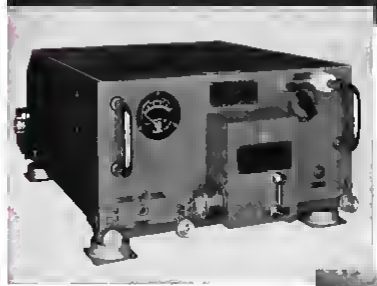
LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIFORNIA, U. S. A.

BENDIX RADIO NEWS

AUGUST, 1941 Published by BENDIX RADIO CORPORATION, Baltimore, Md. Cable Address BENRAD

BENDIX RADIO NOW STANDARD ON EASTERN'S GREAT SILVER FLEET



Eastern Air Lines has ordered Bendix RTA-1 Communication Units (ARINC Spec 508A) and Bendix MN-31 Automatic Radio Compasses to equip the entire Great Silver Fleet. This combination provides complete communication and navigational Radio facilities and represents the maximum of flexibility, coverage and efficiency for air line use with an absolute minimum of weight and space.

Captain Eddie Rickenbacker, President and General Manager of the Eastern Air Lines and an outstanding figure in aviation for over 25 years. Eastern's purchase of Bendix RTA-1 Communication Units and Bendix MN-31 Radio Compasses adds still another to the ever growing list of Bendix equipped air lines.

Don C. McRae, Superintendent of Communications for Eastern Air Lines, who chose RTA-1 Bendix Communication Units and MN-31 Automatic Compasses for Eastern's Great Silver Fleet. The RTA-1 Communication Unit (ARINC Spec 508A) was an outgrowth of an Eastern Air Line development.

Hundreds of RTA-1 Units have been ordered by airlines whose routes literally blanket the country. These efficient Units designed to meet Aeronautical Radio Spec 508A, have 10 crystal-controlled transmitting channels between 2.5 and 13 megacycles with 50 watts output, and 10 crystal-controlled receiving channels. The entire Unit with integral plug-in power supplies, occupies less than 2 cubic feet, weighs less than 75 pounds. RTA-1 Units have been adopted by Chicago & Southern, Delta, Eastern, Inland, National, TWA, and United Air Lines.

16 Air Lines Standardize on Bendix Automatic Direction Finders which simplify aerial navigation by providing continuous visual indication of accurate unidirectional bearings automatically corrected for quadrantal error. Here are the 16 Air Lines:

British Overseas	Mid-Continent
Catalina	National
Chicago and Southern	Northwest
China National	Pan-American
Continental	Penn Central
Delta	Trans-Canada
Eastern Air	United
Inter-Island	Western Air

FLASH!!!

PAN-AMERICAN purchases Bendix TA-2 Transmitters and MN-31 Automatic Direction Finders for their Pacific and Atlantic Clippers.

CHICAGO AND SOUTHERN purchases Bendix Automatic Direction Finders and RTA-1 Communication Units for their entire fleet.

AVIATION

Established 1910

OLDEST AMERICAN AERONAUTICAL MAGAZINE

TWENTY-FIVE YEARS OF SERVICE TO THE INDUSTRY

On the completion of 25 years of service to the industry, AVIATION reviews the past quarter-century of progress in the several fields of aeronautics.

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FLASHES

picked up along the editorial airways

Twenty-Five Years Ago

» LET US PAUSE while we may, to look back on a quarter-century of progress on this, our twenty-fifth birthday. Our reminiscence takes us back to a period somewhat like the present—a period overshadowed by clouds of war. Looking back to those days we find many similarities and many differences.

Although airplanes were delicate concoctions of wood and wire, there were competent attempts to build them out of steel. The second issue of AVIATION, August 15, 1916, carried an article called "Steel Construction of Aeroplanes' by Grover C. Loening, ever the pioneer, whose article on twenty-five years of airplane development appears elsewhere in this issue. In our very first issue we carried a technical description of the 200 hp. Renault engine which we characterized as "one of the most successful foreign engines of great power." We have gone a long way since then.

Military aviation was given some thought in those days but not enough. An editorial in our third issue told how, on August 22, 1916 for the first time in the history of our army, aeroplanes passed in review of their commanding officer, Brigadier General John J. Pershing, somewhere in Mexico. All twelve of these airplanes were powered with engines of 160 hp. or more, and had machine guns, and each carried two 351 automatic rifles with 200 rounds of ammunition. After each flight the laminated wood propellers were pulled and placed in humidors to preserve the viscosity of the glue. Although incendiary and explosive bombs were carried in these ships, no one thought much about airplanes performing any missions except reconnaissance. But it is interesting to quote a statement by General Kitchener who said 'Every aeroplane is worth an army corps."

In an editorial on antiaircraft in the war (Nov. 1, 1916) we reported that the "archies" fired projectiles weighing 8-40 lb. directly upward to 20,000 ft. and that the Germans were using 71 mm. guns firing twenty 11-lb. shots a minute with a vertical range of 20,000 ft.

The superman idea appears in our earliest issues. The pilot is pictured as a man apart in advertising copy that reads: "The new water sport of the superman" and 'The aviator—the superman of now." How shortsighted were these early salesmen who deliberately restricted their prospects to the very few and then wondered why they sold their planes and flying instruction in such limited quantities. It took 20 years to outlive this philosophy and to arrive at the present state of the art where light plane salesmen boast that they can teach anyone of any age to fly and handle the controls on their first flight.

Thumbing through our early issues we find many of our old friends besides those immediately associated with the founding of AVIATION as reported elsewhere in this issue. Freddie Verville appears with a flying boat advertised to "convert the ardent speedboat enthusiast to the virile, man-making sport of flying." Charlie Day who recently made planes in China and is now making them in Canada, was then connected with the old Standard Aero Corporation which took such an active part in World War plane production. An outline of a course of instruction for training aviators by Lawrence B. Sperry was published in our October 15, 1916 issue. Ralph Upson makes his debut with an article on kite balloons in the December 1, 1916 issue. On September 15 we reported the first plane-to-plane wireless message.

And the first air show we reported was the Pan American Aeronautical Exposition, at Grand Central Palace, New York, February 8–15, 1917.

» ALTHOUGH it happens to be our silver anniversary as well as that of several other institutions and organizations in aviation, there is a far deeper reason for looking backward at this time. The industry is passing through a major period of transition. It is changing from little business to big business, from an industry once believed non-essential to one of the greatest and most important of all industries. The future will bring about many changes. Some of the adjustments will be unpleasant. All of us will have to throw overboard some of our pet ideas and replace them with new and better ones. Everyone of us must be able to adapt

himself to new conditions and to grow in stature with the industry. There is much to be learned from a study of the practices of older and larger industries and there are some of these practices that must be avoided at all cost.

» IN PAYING TRIBUTE to the men who have led the industry to its present state, many of whom you will meet in the pages that follow, we have attempted to remember everyone. Despite our best efforts some will be omitted. To them our sincere apologies. We are particularly indebted to those contributors who gave time out of busy days to make this presentation possible, and to those who worked with us behind the scenes. This group includes: Clayton Dearborn of the N A C A, Col. Candee, Capt. Frank Miller, Major Gowan, of the Air Corps; Capt. Mitschner and Mrs. J. B. Hancock of the Bureau of Aeronautics; the public relations directors of almost every plane and engine manufacturing company, and last but not least, the founder of AVIATION, Major Lester D. Gardner, whose cooperation went far beyond the article which appears under his signature.

» IT IS FUTILE TO HAZARD A GUESS at the state of the industry 25 years from now. But the next decade will see great advances. Our people have learned that our security cannot be preserved without an air defense establishment far greater than we formerly thought necessary, and that it must be offensive as well as defensive in character. No matter what the outcome of the present conflict, no nation will ever again dare to be without air power. Even if the dream of the international air force advocates becomes a reality, each nation must contribute in part. As a result, primary industrial emphasis will be placed on the manufacture of aircraft, engines, and accessories for them.

Air transportation will become more reliable and less expensive and ultimately it will provide the only first class travel available. And there will be plenty of second and third class traffic available for the slower railroads and bus lines. A brand new type of semi-first class travel by air will evolve, providing less luxurious accommodations, slower schedules, and more frequent stops. There is plenty of room for this service between present airline operations and present first class railroad service. Similarly, all first class mail and urgent express will go by air. Air mail pickup lines will serve even the smallest communities.

Airplanes still easier and safer to fly and still less expensive will appear for the private pilot and miscellaneous operator. A great expansion in fly-it-yourself services must come to accommodate the hundreds of thousands of pilots who may not wish to own their own planes. Every sizeable community will have an airport and there will be many smaller landing areas in between.

» BUT LET'S GET BACK to the present. There are very few empty seats in airliners these days and the airlines can ill afford to give up any more equipment while the prospect of early replacement is so remote. And everyone is now agreed that the airlines are necessary if we are to increase the tempo of our defense production effort. The reason why our airliners are so much more essential to the British than the bombers, which are available in relatively large numbers, is still a deep mystery. But, if this is the case, the first step would be to increase the transport production which evidently was curtailed by mistake several months ago. Then some of the unused bombers should be converted to transports for either the British or ourselves.

» ANOTHER STEP has been taken toward the independent air force in the recent establishment of the "Army Air Force" under the able leadership of Major General H. H. Arnold. There is much to be said for the idea of independence for our air power, but it is an objective that cannot be attained overnight. Neither does it eliminate the necessity for cooperative air arms for the Army and Navy. Extremists on this subject should remember that we started with a pitifully small nucleus from which to build and that the essential ingredients of air power are aircraft, trained men and bases. When all these are available, in somewhere near sufficient quantities for an independent striking force, and the necessary cooperative arms it will be time to cry loudly for independence if it has not yet arrived.

SAVE TIME BY AIR

"Let Maguire dream a few more minutes before we give him this government expansion order for another 2 000 000 sq. ft."

Side Slips

By Robert Osborn

EDITORS NEVER CHANGE

"GO WEST, YOUNG MAN," said Horace (*Master* Greeley to you please), so we soon found ourself in California where we had a job managing a small gold-mining project known as Sutter's Mill, until some very tough gangsters from Chicago and St. Louis muscled in on us and took over.

This was at the time that Horace

was world famous as an Editor, but he still insisted that the copy material for the Side Slips column be in on time, in spite of the difficulties of transportation which had come about in following his advice. We trust the reader will permit us to reminisce a bit in the Twenty Fifth Anniversary issue of AVIATION, as our purpose is only to show you that Editors haven't changed with the years.

Of course, as mentioned before, this business of getting the copy in on a definite date was quite a problem. We decided that the Clipper ships, sailing down around South America, offered the fastest method of delivery to New York. Many copies of the Side Slips material were made up and one copy given to the skipper of every ship entering the race each month. A beautiful sight it was, too, as "Miss California" fired the starting gun, and the sleek ships, with all sails set, would race out of the Golden Gate into the setting sun. Of course "Miss California" had to be a good shot in those days, but after a great number of public officials had been bumped off we decided to give her a gun loaded only with blank cartridges.

The race to New York was spirited, to say the least, and we fear that the lives of many brave men were lost in the chances taken by the competing captains. You see, the Captain of the winning ship was greeted at the Battery by the Mayor and "Miss New York" and presented with a bouquet and the keys of the city. This generally enabled the Captain to retire from the sea, as the keys they presented in *those* days would actually open the doors of the houses, including the homes of the wealthier citizens.

However, as any ship is subject to the whims of wind and wave, Mark Twain, who was then Editor, insisted on the establishment of the stage coach line through to the rail-head at St. Louis, in order to insure more prompt delivery of our copy. As anyone who goes to the movies knows, these stage coaches were frequently held up by bandits or Indians, but the real reason for these hold-ups apparently has been misunderstood by historians. The breaking open of the Wells-Fargo express box, carried on the stage, was not primarily for the stealing of the gold carried therein, but in order to read the Side Slips column for the forthcoming month in advance of the regular deliveries of AVIATION MAGAZINE to the west, by return stage.

"Marse" Henry Watterson, who had then become Editor, still was not satisfied with the speed of delivery of our copy. This led to the establishment of the famous pony express another fact which seems to be little known to historians of our western frontier.

The pony express operated in a very satisfactory manner, but had a very short existence, as the Union Pacific railroad was completed shortly thereafter, much to the gratification of Joseph Pulitzer, who had taken over the Editorship in the meantime. If readers will examine the pictures taken at the time of the completion of that famous railroad, the conductor of one train can be seen handing our typed copy to the conductor of the other train—the latter reading it with great interest while a couple of people in the background were driving in the last spike, a golden one. Of course, this spike was immediately pulled out by a Government official and transferred to the vaults at Fort Knox.

This delivery of column material by railroad was satisfactory enough until somebody—possibly it was Arthur Brisbane who was then Editor, decided it might be faster if there were a transcontinental air line. In any case, an

air line was started (we hear tell there are two or three of them by now) and the present Editor insists that our copy be sent special delivery air mail, especially when it gets to be a week or so past the deadline for delivery in New York.

It has been the same with every one of the distinguished line of Editors who have headed the world's outstanding aeronautical magazine—Laurence LePage, Sidney Bowen, E. P. Warner, Paul Johnston and now Leslie Neville. They have all had some sort of a complex that our copy should be in by a certain date. Why this should be we haven't the slightest idea, unless the O.P.M. is insisting on the meeting of production schedules.

TWENTY-FIVE YEARS OF AVIATION

The Birth and Early History of the Magazine

By Lester D. Gardner

Dear Les

You have asked me to tell you how AVIATION came into being in 1916 Twenty-five years seems a long time ago Aeronautics was just beginning to be recognized as having a scientific background Previously it had been considered as a field principally filled with daring pilots exhibitionists and empirical experimenters

But by 1916 several aeronautical specialists agreed with me that it was time to begin the publication in the United States of a magazine which would provide the aeronautical profession with the latest and most helpful technical information My closest advisers in those days were J. C. Hunsaker, Glenn L Martin and Grover Loening

Shortly before the publication of the first issue I was able to interest a distinguished group of aeronautical specialists in our plans The Massachusetts Institute of Technology was moving from Boston into its new buildings in Cambridge and I was asked to secure an exhibit of historical aeronautical material The original Wright airplane which flew in 1903 at Kitty Hawk had been crated for 13 years and several floods at Dayton had damaged parts of it With the cooperation of A Roy Knabenshue, I persuaded Orville Wright to reassemble this greatest of aeronautical relics and exhibit it for the first time publicly at M I T He came to Cambridge and was guest of honor at a dinner which had as guests several aeronautical celebrities, including Dr Alexander Graham Bell Those who were to play such an important part in the founding of AVIATION attended the dinner

Lt Jerome C Hunsaker of the U S Navy had been detailed to investigate the possibilities of aeronautics by preparing an aeronautical engineering course He was giving this course at the Massachusetts Institute of Technology when I asked him to become the editor of AVIATION He was then the foremost aeronautical instructor in this country As he had been ordered back to active duty, he could not accept, but agreed to permit two of his students to use their notes taken at his lectures to form the basis of a series of articles which would be the first comprehensive text on aerodynamics to be published in English He suggested that they be written by Alexander Klemin and Thomas H Huff The former was later instrumental in interesting Daniel Guggenheim in aeronautics and for many years has been the head of the School of Aeronautics at New York University It was Dr Hunsaker, now the head of courses in Aeronautical and Mechanical Engineering at M I T, who set the standard of technical excellence which has always been the aim of the editors of AVIATION.

Dr Hunsaker interested his students at M I T in the project Several years ago in writing regarding the beginnings of AVIATION he referred to them as "the hard boiled scholars of this first group at M I T included V. E. Clark, Donald Douglas, T. H Huff, A Klemin, E P Warner, Ralph Weyerbacher B Q Jones, H W Harms and Garland Fulton Starling Burgess, Frank H Russell and Luis de Florez were then making experimental 'inherently stable' seaplanes at Marblehead, and Grover Loening was struggling with 'all metal' airplanes at Sturtevant Capt Tom Baldwin gave lectures usually after hours and I am sure we learned more of what aeronautics was, and was not, from him than we realized then To all of this crowd, AVIATION became a personality. Gardner was our friend and Gardner was AVIATION His success was our success Actually the support of a few of us in the early years of AVIATION was of more help to us than to Gardner, but we still like to think of AVIATION as *our* paper when it would be more precise to speak of it as *the* paper."

Glenn L. Martin, with that farsighted vision which has characterized his whole career, urged me to found an aeronautical engineering journal His encouragement was backed by the advertising of his company and he has the distinction of having been represented in every issue of AVIATION for the past 25 years, probably a unique record in aeronautical advertising

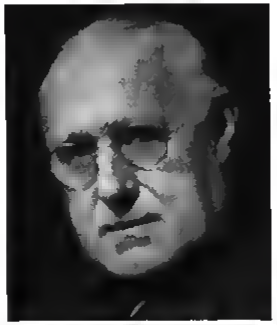
Grover Loening, who had been the first U S Army Aeronautical Engineer and also a manager of the Wright Brothers' first company, advised me as to policy and was largely responsible for the editorial trend that the magazine followed

In 1916 the possibility of our being drawn into the World War was similar to the present outlook The airplane was just beginning to be regarded as having military uses Philip J Roosevelt served as Military Editor of AVIATION until he joined the Air Service, as it was then known, in 1918 The first member of the staff was George Newbold, and he is still contributing his long experience to its publication activities

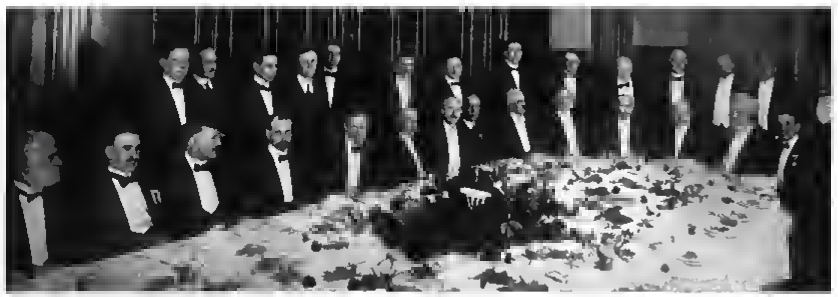
During the War, when I was on active duty in the Air Service, Ladislas Dorsey edited AVIATION and contributed greatly to broadening its scope While editor of AVIATION, he founded the order of Quiet Birdmen

Edward P Warner, who is now Vice Chairman of the Civil Aeronautics

(*Turn to page 188*)



Lester D. Gardner who founded Aviation in 1916. He was a Major, Air Service during the World War, President of the Aeronautical Chamber of Commerce of America, flew over practically every European airway from Moscow to Casablanca and Baghdad to Stockholm. In 1932 he organized the Institute of the Aeronautical Sciences and is its Executive Vice-President. In 1939 he was made president of the Aeronautical Archives.



Dinner in honor of Orville Wright, Boston June 12 1916. Seated, left to right, John Ritchie, Jr., Massachusetts Institute of Technology Publicity Mr C P Page Van Blerk Motor Co A E Kennelly Prof. of Electrical Engineering M I T; E B Wilson, Prof of Mathematics, M.I.T.; Philip J. Roosevelt, Military Editor, *Aviation*. J. P Monroe Sec'y of the Corp., M.I.T.; G. L. Cabot, Pres., Aero Club of New England, Paul W Litchfield Pres., Goodyear Tire & Rubber Co; Prof. Byerly, Harvard. Rear Admiral Washington Lee Capps, Ch. Constructor, U.S.N. Orville Wright; Prof C. H. Peabody, Head Naval Architecture Dept., M.I.T.; Dr. Alexander Graham Bell, inventor of the telephone and organizer of Aerial Experiment Association; Edward M. Hagar, Pres., Wright-Martin Co. Standing, left to right J. H Satterlee, Wright-Martin Co.; Lester D. Gardner, Publisher, *Aviation*; Roy Knabenshue, pioneer balloonist and manager Wright Exhibition Co.; Prof. J. C. Riley, M.I.T., Raymond Ware, Thomas Motor Co.; Thomas Huff, Instructor, Aeronautical Engineering, M.I.T.; Alan R. Hawley, Pres., Aero Club of America; Glenn L. Martin, Martin Aeroplane Co.; Oscar Brindley, winner of Curtiss Marine Flying Trophy; Prof. R. W. Willson, Harvard. A G Webster, Prof. of Physics, Clark University; Dr J. D. Hunsaker, Assistant Naval Constructor, U.S.N.; James Means, Publisher, Aeronautical Annual 1895-7; Alexander Klemin.

Geo. Newbold only executive continuously with Aviation since the first issue. Earlier jobs were editor of 'American Defense' and nine years on 'Panama Morning Journal'

Editorial from first issue of Aviation

August, 1916

The future of the aeroplane will depend largely on the use that is made of the technical information that is being gathered in all parts of the world. As this material is made available to the constructor and engine maker, they will find its utilization more and more imperative for the scientific improvement in design and construction from the standpoint of safety and efficiency. Aeronautics has passed through the period of rule of thumb designing and empirical experimentation It is now a recognized science subdivided into many branches, and those who are working in aeronautical engineering can rightly claim that it has reached the dignity of a profession

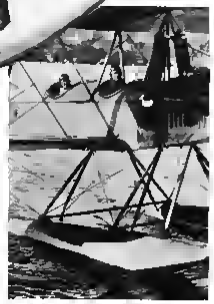
Aviation and Aeronautical Engineering intends to assemble this vast amount of material and make it useful to the constructor, the engine maker, the aviator and the sportsman It will follow construction both abroad and in the United States, and present the latest developments in accurate, scientific and unbiased form. It is hoped that by undertaking this task a great stimulus will be given to the whole aeronautical profession By recording the work of American aeronautical engineering, the world will soon be made aware that the birthplace of the aeroplane is still maintaining its leadership in aeronautics. By presenting in usable form the work done abroad by the leaders in this field, *Aviation* will perform a service of incalculable value to American industry.

It is hoped that by undertaking this great task a stimulus will be given to the whole aeronautical profession, the members of which will find in the new publication a continuous source of reliable information as well as a medium worthy of receiving and transmitting to the aeronautical world the results of their valuable experiments, researches, constructional developments and matured views on the many controversial aspects of this great branch of engineering

We Knew Them When . . .

Brig. Gen. Carl Spaatz now Executive Asst to Gen Arnold, as a Major in 1930

Above Don Douglas is appointed M.I.T. asst of $500 per year June 9 1914. Right: in 1920 the Davis-Douglas Co. operated in the Kell Fleming Mill, Los Angeles. Left: Don Douglas; right Geo Stumpf, new director of inspection standards for Douglas.



Joe Horizon Estes Vice Pres. of Martin, in the front cockpit of a Boeing seaplane in 1916

Lt. Jimmie Doolittle in 1926.

The one and only Casey Jones as he looked in a Curtiss pushes in 1915.

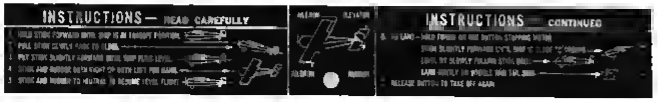
Glenn L. Martin, who has exerted a tremendous influence in aviation, as one of the country's earliest barnstormers

Thomas A. Morgan President of the Sperry Corp as he appeared in 1911.

L to r: Paul Richles, Tommy Tomlinson Jack Frye Walt Hamilton in 1922.

Jake Kindelberger of North American has been around a long time but we have an early picture of him.

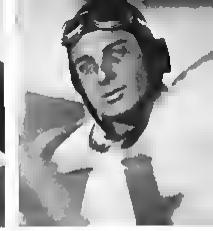
Brass plate below was mounted in cockpit of a Curtiss plane. Was found by Sperry engineers at Garden City.



Carl Squier, now Lockheed's vp. in an Eastman flying boat in 1922.

Otto Timm built this plane and taught himself to fly in 1911.

Bill Boeing all wrapped up for a ride in one of his early planes



Lt. Lee Arnold now E.A.L., on a round-the-world flyer in 1924.

Charlie Lawrance of Lawrance Engineering

Wartime view of Hamilton Prop's. Hay croft Welsh

Jean Trippe gets Collier Trophy 1927 Tom Beck smiles

Benny Greulx Thompson Bros. parachute jumpers way back when

Gene Wilson of United Aircraft as Navy Commander

Aviation's first publisher Lester Gardner

Curtiss Wright's President Guy Vaughan.

Sperry Gyro's President, R. E. Gillmor in 1911

Young C. R. Smith now boss of American Airlines, as he looked 10 years ago.

LeMotte Cobu, now Board Chair man of Northrop Aircraft, same years ago

A couple of great guys Left Harry Guggenheim, right Bill Stout with one of Bill's famous Ford tri-motors.

Left Air Corps Capt. C. C. Moseley winner Pulitzer Race in 1926

We Knew Them When . . .

They designed the Curtiss Condor in 1927. L. to r.: T. P. Wright Chief Engineer; Lieut Eugene Batten test pilot; R. B. Beisel, Design ass't.; Geo. Page, Project Engineer.

Edgar N. Gott, now VP. for Consolidated, is shown in a 1931 scene when he was President of Keystone, with a Keystone bomber in the background

Burdette Wright gen'l mgr Curtiss Wright Buffalo plant.

Preston Bassett V.P. & Chief Engineer of Sperry Gyro, in 1923.

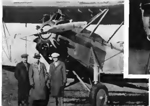
Col. Ira Eaker has established many records. In 1936 he made first coast-to-coast blind flight in this ship

E.A.L. president Eddie Rickenbacker as he appeared in the mid twenties following his famous war years.

Roy Grumman has been designing planes a long time.

"W. A. Patterson, U.A.L. president takes time off from his airline to try out some real horsepower at Walla Walla

1929 Stearman Speed Mail with, l. to r., J. E. Schaefer, Sales Mgr., Lloyd Stearman, president; Mac Short Chief Eng



Major Reuben Fleet President of Consolidated Aircraft.

George F. Chapline who now runs Brewster Aeronautical Corp

The late Harry Weisel when he was running the 1929 Air Races

Col. Edgar Gorrell, former Chief of Staff of A.E.F. air forces now President A.T.A

Jack Northrop as a 1919 designer for the Loughead brothers of Santa Barbara.

Benny Howard when he worked for Alexander Aircraft.

Arthur Noll of Wright Aeronautical. We don't know the date

Everybody's friend, the great Eddie Stinson in the early 1920's.

Dick Depew when an Army captain with an Avro test plane at Farmingdale

W. B. Bonner engine builder, has been flying since 1919

Wright Aero's Myron Gordon as he looked about 1935

Ralph Damon when president of Curtiss Wright in 1934 (American Airlines photo)

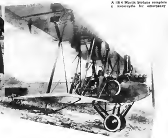
Lockheed's Bob Gross who gets busier every year of his life

Pratt & Whitney's Gen Manager H. Mansfield Horner

Earl Osborn, of Edo who bought Aviation from Lester Gardner.

Bob Osborn left, and T. P. Wright designers of the Curtiss Tanager.

A 1914 Martin biplane complete w[ith] a motorcycle for emergency u[se]



The Growth of Army Aviation

From 1916 to 1941 an entirely new concept of air power has grown up in the Army. Here are some of the high lights of Army aviation history

The present Deputy Chief of Staff for Air and Chief of the Army Air Forces was among the earliest aviation pioneers. On the occasion of our 25th Anniversary he has sent the following message.

AIR POWER THEN AND NOW

By Major General Henry H. Arnold

Twenty-five years ago, only a mere handful of us engaged in military flying believed in aviation. Although this nation was on the very eve of entry into the First World War, even we hardly foresaw that the airplane would evolve into such a mighty instrument for destruction. We sensed the profound implications of its potentialities, or we would not have dedicated our lives to its development. When the United States entered the World War we had only about 35 pilots and 55 training planes. Everyone knows how the aviation industry, which had had little preparation, support or even encouragement, responded to the unprecedented demands imposed upon it by the World War. Everyone knows that during the 18 months prior to the armistice we had trained thousands of pilots, had thousands of military airplanes, and on November 11, 1918, had an air service in which both the nation and ourselves took pardonable pride. Then came the lean, starvation years, when we were forced to think in terms of one airplane, or at most ten airplanes, where today we are thinking in terms of thousands of airplanes. Today almost everyone recognizes air power for what it is, and our faith has been justified.

Today we are engaged, with the help of the American aviation industry, in producing the greatest air force in the world. Because everyone now knows that anything short of the best will not be good enough for our national defense.

TWENTY-FIVE years ago "air power" was receiving its first practical tryout in the United States. But it wasn't called "air power" then, it was just a small branch of the Army's Signal Corps that began operations with the Mexican Punitive Expedition in the spring of 1916.

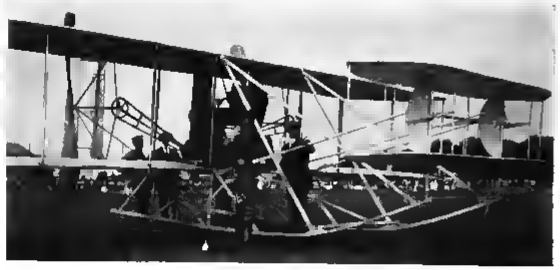
Less than two years earlier the Aviation Section was formally established within the Signal Corps. And a year later, when the United States entered the World War, our "airpower" consisted of 35 pilots, 1,087 enlisted men and 55 training planes. An aeronautical division had been established as far back as 1907, but it was not until August 2, 1909 that the War Department approved the acquisition of its first airplane, a Wright "pusher" in which the pilot and passenger sat upright on the leading edge of the lower wing.

By 1916 the Aviation Service had acquired 16 planes of a little more advanced design. Some of these went to the Mexican border. Sometimes the pilots could barely coax them off the ground when the air was too hot and "thin."

Progress seemed slow in those days. True, improvements came one after another as the years ticked off, but we didn't have anything to measure progress against. There was no perspective in time. Not so, today. The years sped by until we called them decades. Now it is 25 years since that essential campaign in Mexico. We call it a "quarter century" and it sounds like a pretty impressive slice of modern history.

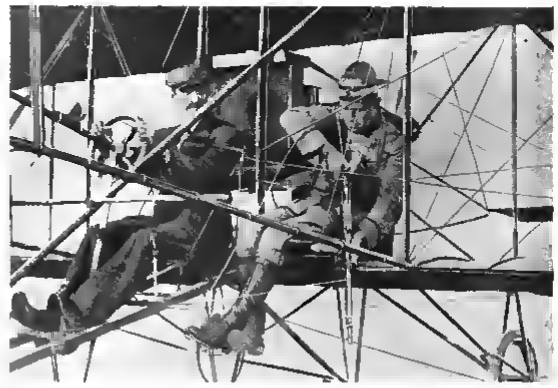
We've got perspective in our picture now, sharply foreshortened though it may be. Twenty-five years ago those simple contraptions fashioned of wood and fabric and bits of metal putt-putted over the treetops at 50 or 60 miles an hour for a couple hundred miles. Their engines were not very reliable and they were difficult and uncertain in maneuvering.

Major General Henry H. Arnold when he was a Lieutenant, in a Wright biplane at College Park, Md. in 1911. He has been flying continuously since that year. He recently made his appearance in a glider at the Elmira Soaring Meet. A more recent picture of him is on page 230



The first Army airplane at Ft. Myer, Va., July 27, 1908. L. to r.: Lieut. B. D. Foulois, Wilbur Wright, Lieut. Frank P. Lahm and Orville Wright. Air Corps photo.

In France during the war many Americans received instruction on these monoplanes. Photo taken Aug. 30, 1917.



In 1910 Lieut. Jacob E. Ficket flew with Glenn Curtiss over Governor's Island to prove an airplane could be used by sharpshooters.

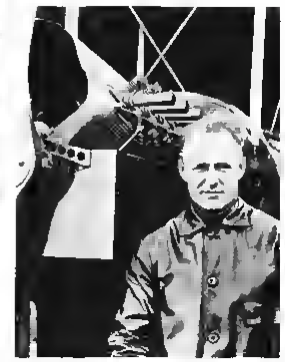
sure and accurate, limited in most cases only by physiological limitations of pilot and crew members. Medical science is even stepping in here to devise ways of permitting increasing strains on personnel without their suffering irreparable damage.

The same space of time has seen this upstart instrument of war, military

(*Turn to page 218*)

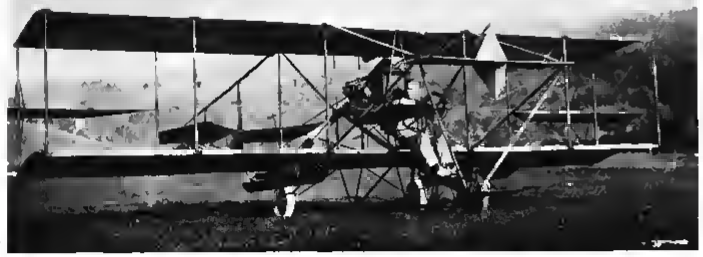
The modern miracles of scientific precision are constructed of light strong metals. Engine failures are so rare as to constitute a minor cause of accidents and interruptions to operation of aircraft. Newest types of American fighters have top speeds in excess of 400 miles an hour. Giant bombers capable of ranging thousands of miles from their bases with tremendous loads, drone hour after hour through night and day at better than 300 miles an hour. They are equipped with bunks and galleys so that their crews may eat and sleep and work in shifts.

Maneuverability of modern aircraft is



Major General George H. Brett, now Chief of the Air Corps, when he was a 2nd Lieutenant on Oct. 28, 1915.

Kelly Field was proud of its new DH-4 Bs lined up here for a wartime inspection.



Young Jack Towers at Hammondsport in July 1911. This Curtiss pusher was the second plane to be delivered to the Navy.

A Quarter-Century of Naval Aviation

By Rear Admiral John H. Towers *Chief, Bureau of Aeronautics, U. S. Navy*

Editor's note: Admiral Towers rightly deserves his place as chief of Naval aviation. He has many firsts to his credit. He was taught to fly by Glenn Curtiss in 1911. That November he and Lieut. Ellyson made the Navy's first long-distance flight of 148 miles. In 1913 he was pilot on the first scouting flight for the fleet as well as dropping the first bombs on stationary targets. He also set a world's seaplane endurance record that year. In 1914 he was in charge of first instruction of the new base at Pensacola. He worked with Glenn Curtiss on first long-range flying boat in 1914. In the war years he had the important post of Naval attache in London. Following the war he organized and was in command of the famous flights of the NC boats. Since then he has been active in every phase of Naval aviation. He became Chief of the Bureau in 1939.

WHEN the first issue of AVIATION appeared in August 1916, there was little activity in Naval aviation for it to chronicle. We had just one Naval Air Station, a few airplanes and even fewer pilots. From the vantage point of today, when the Navy has what we believe is the most efficient air arm of any fleet in the world, with patrol and combat squadrons with every unit of the fleet and with air stations from Alaska to Panama and from the North Atlantic Coast to the far reaches of the Pacific—it all makes the events of 1916 seem very far away.

Naval aviation began officially in March 1911 when the Navy let contracts for two airplanes with Glenn Curtiss and one airplane with the Wright brothers. This formal recognition of aviation came after three pioneering flights had proved that airplanes might be of some value to the Navy. In November 1910, Eugene Ely, a civilian pilot working for Curtiss, had made a take-off from a platform constructed on the bow of the U. S. S. Birmingham at Hampton Roads, Va. This flight, the first of its kind anywhere in the world, might be called the birth of the aircraft carrier. Two months later, on Jan. 18, 1911, Ely proved that he could not only take off from a ship but that he could land on one. The U. S. S. Pennsylvania, anchored in San Francisco Bay, was equipped with a platform built over the quarter deck. Ely flew a Curtiss plane from a near-by field, landed on the ship and then took off a few hours later.

The third significant flight, which was to be the forerunner of another kind of Naval aviation, took place the following month. In one of his planes equipped with floats, Glenn Curtiss flew out over the waters of San Diego Bay and landed alongside the Pennsylvania. He and his hydroplane were hoisted aboard the battleship, to demonstrate it could be done, and then lowered to the water. Curtiss then took off and flew back to his base. Now every U. S. battleship and cruiser has seaplanes that are handled in this way.

There were many other "firsts" in those early years, some of which seem both easy and obvious as we look back on them. But at the time they required a vast amount of study, experimentation and initiative, to say nothing of engineering and flying talent. In 1912 Glenn Curtiss tested the first flying boat at Hammondsport, N. Y., which had been designed for Navy use. Also that year Lieut. T. G. Ellyson made the first successful catapult shot, at the Navy Yard in Washington, D. C.

Step by step our experience in this new field of naval aviation grew. In 1913 we made the first scouting flight for the fleet, dropped the first bombs from naval airplanes, flew the first amphibian and set new altitude and endurance records. Also that year brought a new board of seven officers, appointed by Acting Secretary of the Navy Franklin D. Roosevelt, to draw up plans for a Naval Aeronautic Service.

U. S. Navy

Left: Forerunner of the catapult. In the summer of 1911 this Navy Curtiss pusher was launched at Hammondsport from a cable. Lieut. J. H. Towers at the left, Lieut. T. G. Ellyson pilot, Augustus Post holding the steadying line, center.

In the three years that followed, progress was slow but steady. When war was declared on April 6, 1917, the Navy had the following personnel and equipment: 38 pilots, 163 enlisted men, 6 flying boats, 45 seaplanes, 3 landplanes, 7 balloons, 1 non-rigid airship. We had one Naval Air Station, at Pensacola, Fla.

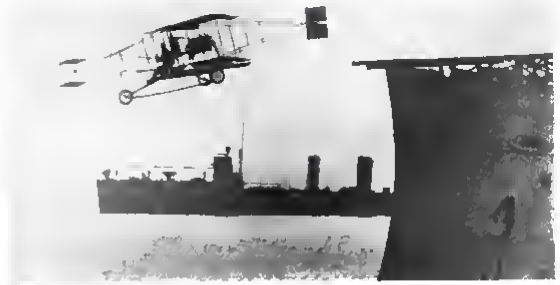
Expansion during the war was rapid, as is shown by the fact that on Nov. 11, 1918, Naval aviation consisted of 44 Naval Air Stations, 3,049 officers, 43,462 enlisted men, 3,912 student officers, 2,107 airplanes of all kinds (including 1,172 seaplanes), 292 balloons and 15 non-rigid airships. Of the above, 388 seaplanes, 152 landplanes and 48 kite balloons were sent overseas. Some 1,237 officers and 16,287 men went abroad for aviation duty. Of the 44 stations, 25 were overseas, 2 were in Canada and 1 was in the Azores. Our Naval planes made their first patrol along the French coast in November 1917 and various units were on active duty in Europe from then until the war ended.

Because "big boat" operation is now such an important part of naval aviation, a few words about its early development may be in order. Glenn Curtiss had taught me to fly in 1911, and we had spent considerable time together that summer and in the months that followed. We often talked about the possibility of building a flying boat that could cross the Atlantic. Rodman Wanamaker became interested in the same possibility and asked Curtiss to build a big boat that could make such a flight. Curtiss visited me in February 1914 asking me to come to Hammondsport to work with him. The Navy approved, as we were all much interested in the prospect. With the help of the small Curtiss staff, designs were made and the "America" was built. For those days it was a large ship. The hull was 35 feet long with a 6 foot beam. The upper wing had a span of 72 feet with a chord of 10 feet. Two 200hp pusher OX engines were mounted between the wings. Many changes had to be made before the boat was able to take off with the large amount of gasoline needed for a long flight. Just as the flight was about ready the war intervened and all plans were cancelled. The "America" crossed the Atlantic—

(*Turn to next page*)

U. S. Navy

Pensacola in 1914, the Navy's only aviation base.



U. S. Navy

On Nov. 14, 1911 Eugene Ely flew a Curtiss plane off the deck of the U. S. S. Birmingham. This was the first flight from the deck of a ship.

U. S. Navy

On Jan. 18, 1911 Ely landed a plane on the deck of the U. S. S. Pennsylvania and a few minutes later made a successful take-off. This shows landing with ropes and sand bags used to arrest the speed of the airplane.

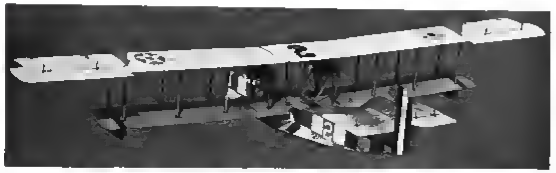
but on the deck of a steamship bound for England.

During the war the size of flying boats used in Navy patrol work became greater. Curtiss built his "F" boats as well as his "H" boats, and other manufacturers also built similar craft. As the menace of German submarines grew, it was realized that there would be a real advantage if flying boats could be built that were capable of flight to Europe. In December 1917 the Navy ordered four flying boats from Curtiss that were to have a wing span of 126 feet and an over-all length of 68 feet. Tanks were to carry 1,800 gallons of gasoline for four Liberty engines of 400 hp. each. These were the now famous NC boats. The first of the series, the NC-1, was test flown in October, 1918 and the following month proved its load carrying capacity when it went aloft with 51 persons.

With the signing of the Armistice in November there was no need for flying the boats to Europe for war purposes but the boats were ready and as we all felt sure they could actually be flown across the Atlantic the flight was decided on. Although four boats had been built, the wings of the NC-1 had been damaged so those of the NC-2 were used to replace them, and consequently we had only three boats for the flight. We left the Rockaway Naval Air Station in May, 1919, each boat with a five-man crew, and flew to Trepassey Bay

The first of the long-range Curtiss flying boats built for a trans-Atlantic flight at the time of the launching in July, 1914. Glenn Curtiss is at the left.

The great NC-4—the first airplane to cross the Atlantic.



In this Navy F5-L is Asst Sec'y of the Navy, Franklin D. Roosevelt, being flown from New York to Newport in July, 1918. The Navy used many of these boats for war patrol work.

Left: The Navy has used many types of flying boats. This is a 1928 Consolidated seaplane, the forerunner of today's patrol bombers.

Newfoundland, from where we took off on the 16th for the Azores. The NC-1 and NC-3 were forced down by bad weather near our goal. The NC-1 sank after its crew had been rescued by a Greek steamer, but the NC-3 taxied the final 200 miles to Horta. The NC-4, with Lieut.-Commander A. C. Read in charge, arrived successfully at Horta, then flew on to Lisbon, and finally up to Plymouth on May 31, for the first trans-Atlantic flight.

An event of great importance took place in 1921 when the present Bureau of Aeronautics was formed. For the first time this brought all naval aviation activities under one head, and brought smoother operation and greater effi-

(*Turn to page 234*)

Twenty-five Years Of Aircraft Manufacturing

By Col. John H. Jouett

President, Aeronautical Chamber of Commerce

THE aircraft manufacturing industry of the United States is now completing the first 25-year cycle of its history as an industry, and is beginning another. History is repeating itself.

Twenty-five years ago—in 1916—a few manufacturers were beginning to fill orders received from the Allies for aeronautical equipment. Official Washington knew that only a miracle could keep the the United States out of the World War. The Army and Navy increased their orders. The War Department, at first planning for an expeditionary force of a million men, estimated that one plane per thousand men, with reserve machines, would require 2,500 planes. The industry, as it was then constituted, said that it could handle that production at once, because it had as a result of its foreign orders certain plant facilities and about 5,000 employees trained in such work. Then Allied missions arrived. They soon convinced the Government that 25,000 planes were needed. It meant a tenfold expansion for the Army alone, besides the program for the Navy. The motor car industry claimed that it could help materially. It received large orders.

On recommendation of the then Acting Secretary of the Navy, Franklin D. Roosevelt the various Government bureaus sat down with the industry and organized the Manufacturers Aircraft Association to handle an airplane patent cross-licensing agreement, to prevent costly litigation and make inventions available to all manufacturers. Incidentally, it has been eminently successful, and it still functions for the benefit of all concerned, including the government.

The production program of 1917 was expanded. It called for 20,000 combat and 9,000 training machines. There were questions of priority in labor and materials. The draft threatened to deplete the labor market. Plant protection was an important item. Army orders amounted to about $350,000,000 for planes, engines and spare parts during the war. The industry meanwhile expanded plants and payrolls. At the time of the armistice it employed 175,000 persons. It had built 9,742 planes and 14,765 engines for the Army, besides hundreds of ships for the Navy and huge quantities of spare parts for the Allies. That did not include the output from the motor car and other industries. On the day of the armistice the entire American production was at the rate of 21,000 planes a year.

At that time there were 24 aircraft companies, some of them small and experimental, but all under way toward important contributions to the war effort. They had a total capitalization of about $23,000,000. Within three months following the armistice the industry was being liquidated to 10 percent of its war strength.

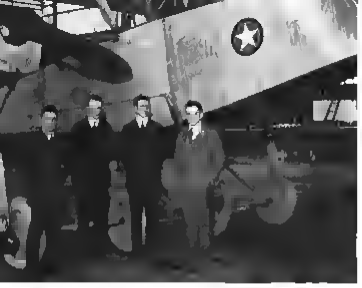
The story of the industry's postwar struggle is well-known to AVIATION readers but a few of the facts will bear repeating here. By and large the men who are managing the aircraft manufacturing companies today were either in the industry or in the aviation services during the last war. Soon after the armistice they organized the Aeronautical Chamber of Commerce of America as a trade association to act for them in all group efforts of interest to the industry.

The executives of the individual companies possess a great background of practical experience in design and engineering, in construction and shop practice and in knowledge of the requirements of a defense program. In other words, our aircraft manufacturers today are veterans, in one way or another of the last war; and that is why they have known how to handle the tremendous tasks imposed by the present emergency.

When the emergency became a reality in September, 1939, the industry had about 89,000 employees and 13,000,000 square feet of plant space, partly as a result of expansion due to orders from Great Britain and France, as well as augmented orders from our own air forces. Some companies, with orders for hundreds of planes of the same model, had been able to set up assembly facilities approaching quantity production—just as some companies had done prior to our entry in the first World War.

At the same time the industry, realizing that inevitable expansion would require a tremendous increase in personnel, set out to secure tens of thousands of new employees and train

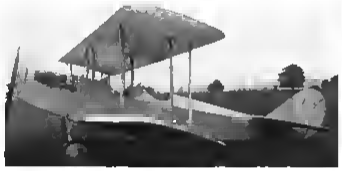
Glenn L. Martin's first factory was this abandoned church in Santa Ana, Cal. in 1909. Today he has this huge plant in Baltimore and soon will have two other factories.



Many of the industry's engineers first worked with Glenn Martin. Here before the first Martin bomber, are (l to r) Larry Bell, then General Mgr. for Martin; Chief Test Pilot Eric Springer; Glenn Martin; Chief Engineer Donald Douglas. Time: 1915.

Many planes rolled out of the Dayton Wright factory. This is an FP-2 made in 1921.

A war time Vought combat biplane



An early 1924 Waco

In his own amphibian, Major Alexander de Seversky shown above set a new world's amphibian speed record of 230 m.p.h. First ships were built in 1931-32.

From 13,000,000 square feet of plant space on January 1, 1940, those companies increased plant space to nearly 35,000,000 square feet on June 1, 1941.

According to present estimates, employment will nearly double and plant space will increase by 15,000,000 square feet by the end of this year. That, of course, will not include plant expansion by the motor car industry to fill aeronautical contracts.

Some of the problems are similar to those of 1917–1918. Take priorities. At present there are several bottlenecks despite the fact that aircraft manufacturing is on the preferred list. As one bottleneck is relieved in one plant, another usually turns up to take its place. Securing of all the materials essential to aircraft production will continue to be a problem of major importance.

There is a distinct possibility that as the defense program gets into full swing, the plants may encounter difficulty in securing the additional thousands of new personnel. Military service and the requirements of other defense industries may create a shortage in certain localities. However, we foresee no shortage which proper planning by the government cannot prevent.

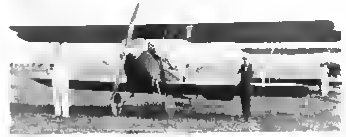
The first Sikorsky, the S-29-A built in this country and completed in 1924. It was the first of a long line of successful ships built here. Mr. Sikorsky in the foreground.

A 1927 Cessna, with internally braced wings. Cessna has built planes continuously since 1911.

Lell S. S. Bradley, organizer Mfgrs. Aircraft Assn., 1917; Aero Chamber of Commerce, 1921. Now Board Chairman of M.A.A. Center: Frank H. Russell now President of M.A.A. which has handled pooling of aircraft patents so well litigation is non-existent. Formerly was Gen'l. Mgr. of Wright Aero, when it was Curtiss Aeroplane and Motor Co. Right: Virginius E. Clark in 1921. A pioneer in design and research, he developed the Clark Y airfoil and Duramold plastic-bonded plywood. He is now doing experimental work for Hughes Aircraft.

The first Fairchild, production model the FC-1A, built in 1927. Engine is a 200 hp Wright Whirlwind.

Walter Beech, shown above, began building his Beechcrafts in late 1932 and this is one of his first ships. It brought new speeds to private flying.



A 1925 Travel Air. Walter Beech, then general mgr. of Travel Air, won both the 1925 and 1926 Ford Reliability Tours in his company's ship.

One of the early Grummans the XSF-1, built in 1932. U. S. Navy photo.

them in the plants. One of the greatest accomplishments of the industry has been the success with which the manufacturers have put men at work and, at company expense, trained a new army for defense production.

There are now upward of 33 airplane, 10 engine and 4 propeller companies working on defense orders, not including the motor car companies and others which are preparing for production, largely as subcontractors under the Knudsen Plan.

Just as the program was expanded during the last war, so is the program changing from day to day in this war. As our government and the British realize that they must have more planes, the directives change. At first, light bombers and pursuits were considered quite enough to hold the Germans beyond the Magnot Line. After the fall of France, Britain asked for faster pursuits and bombers with longer range. With the war zones extending far over the Atlantic and into Africa and the Near East, the need for larger numbers of American planes of all types has grown at an increasingly rapid rate. The initial objective a year ago was about 15,000 planes for our own air forces. On January 1, 1941, that objective had become 37,000 machines for both American and British air forces. A few weeks ago the total was jumped to 44,000 planes. Besides, a new program contemplates 2,400 twin-engine and 1,200 4-engine bombers in addition to those already on order. Today there are still greater objectives approaching the order stage, and they may raise the 44,000 goal to more than 80,000.

From 89,893 employees on January 1, 1940, the plane, engine and propeller companies had on their payrolls 262,671 on June 1, 1941.

One of the great airplane factories of the last war was the Standard plant at Elizabeth, N. J. This poster proclaims the planes turned out, including the J.1, H boats, DeHavillands, Capronis, Handley Pages and a variety of Standards.

On this photograph of the mighty Douglas B-19 has been superimposed a photograph of a Curtiss JN-4 to show the relative size of the two ships. The difference in these planes indicates the growth in planes in 25 years

Twenty-five Years of Airplane Development

In the span of years between the Jenny and the B-19, a great deal has happened in the growth of the airplane.

By Grover Loening

SOME clear and not too pleasant lessons are to be learned from a questioning and reflective perusal of the last 25 years development of the airplane. While detailed tables, charts, etc., showing the exact increases in weights, in loadings in percentage of structural to useful loads, etc., would be illuminating, a more general philosophical survey of where we really stand and why, would, perhaps be of equal value.

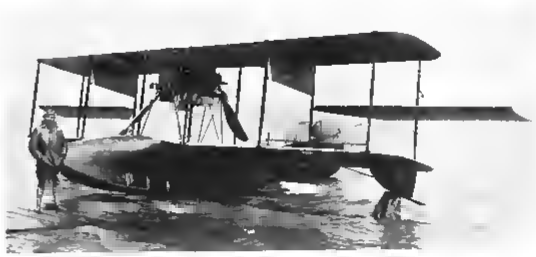
One of the most outstanding lessons that we see clearly in such a review is how often designers and constructors fail to finish up what was started. Due to discouraging initial troubles and bugs—added to lack of foresight and interest on the part of the customers (the Army or the Navy) continuity of effort frequently has diverged into other lanes with the result that needed development work that had been started was abandoned only to be revived years later.

There are no end of examples. The Curtiss Conqueror liquid cooled engine

Grover Loening who has been actively engaged in aviation since 1910

was winning world speed records from the best liquid-cooled engines in the world in the late twenties. Why was it dropped? The four-engined NC-4 had crossed the ocean in 1919 but the Navy dropped the further development of long range four-engine maximum size aircraft for many years and the trend was not picked up until the advent of the Glenn Martin and Sikorsky Clippers. Outstanding as a further example was the fact that the Curtiss Racers that established so many records constantly for years from 1923 to 1929 were never followed up by the development of an Army pursuit plane of the same design. The reason frequently given was that the wing radiator was impractical. But, is that any reason for the Curtiss Hawk not to have had the same wing section and wing structure and streamlined fuselage as the racer?

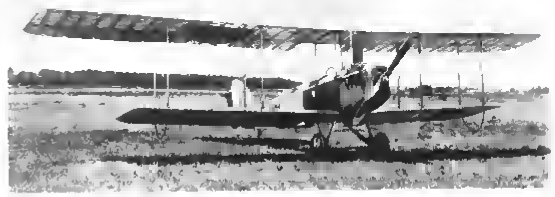
A graphic, recent, and somewhat shocking example of this is the story of the leak-proof gas tanks. In the early 1920's they were required as mandatory equipment on all Army Air Corps fighting aircraft. They were



TWENTY FIVE YEARS OF SERVICE TO THE INDUSTRY

An early Curtiss flying boat

Eddie Molley, now Factory Works Mgr. at Ryan Aeronautical, is shown here in a Sturtevant biplane designed by Grover Loening. The time: 1915



A 1917 Standard J-1 with Curtiss OX-5 engine

practical—their production had been well worked out and provision made for them in all designs—but gradually they were given up instead of being further developed. Why? Particularly is this question pertinent when we think of the hysteria of ten or eleven months ago to get them back.

The lesson one seems to gather from these numerous instances is the unpleasant one that aviators' likes and dislikes are given too much weight in discouraging the engineers from perfecting their developments. This condition is, perhaps, less prevalent now than it was in the twenties and even in the early thirties. But, in retrospect one can now put one's finger on many instances where worthy developments were abandoned because they were politically and diplomatically unwise—because the Army and Navy officers did not want something that they themselves did not appreciate. Many a wing flutter that scared a test pilot condemned to utter oblivion a plane that had structural or military features of great importance and advantage—that would have been perfectly acceptable had the Army and the builder at that

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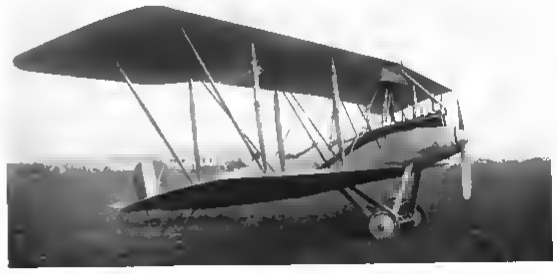
Sherly Shroeder set a world's altitude record in this Loening M-8 in Dec. 1918. Wing design and lift struts were advanced for the time. Engine was a 300 hp Hispano.

A 1918 L.W.F. (laminated wood fuselage) with a Hall Scott 125 hp engine.



As We Were

Random reminiscences of the NACA of twenty-five years ago as told to the Coordinator of Research by Dr. George Lewis, John Victory, Dr. Edward Warner, Dr. William Durand, and others of the early organization

By S. Paul Johnston

WHEN AVIATION magazine first saw the light of day, the National Advisory Committee for Aeronautics, a lusty yearling, was cutting its first teeth Fortunately, they were strong ones, for little time was then available for practice bites on patented teething rings The flames of the first World War were already licking out across the Atlantic, and in their glare we were beginning to see the pitiful deficiencies of our own aviation effort. In the emergency, the best brains in the country were needed to formulate research policies and to suggest procedures After some backing and filling, a group was finally assembled in Washington early in 1915 to advise the President on aeronautical matters. That Committee immediately found its milk teeth set in problems tough enough to require some powerful and persistent mastication.

We already knew how to make airplanes fly—after a fashion The Wrights had taught us that some ten years before But under the threat of impending war suddenly we woke to the fact that we were trailing the field in military aviation While the United States had been content to look on the airplane as a sort of amusement device—a new and more thrilling version of the man on the flying trapeze—the more military-minded countries of Europe had been considering its potentialities for war. Even in 1914 the air scouting fleets of the Powers were not inconsiderable France had 1500 military airplanes,—Germany 1000, plus 14 Zeppelins Although England could muster less than 100 planes to send to France with the first Expeditionary Force, she had more than a little background in military flying We were in far the worst shape of the lot. The best we could do was to whip together a doubtful dozen machines to send with Pershing into Mexico in 1915

Another good index to the general state of affairs is to be found in the record of the aeronautical spending of the Great Powers between 1908 and 1913 Germany put down some $32,000,000 for aircraft in those years France ran a reasonably close second at $25,000,000,—Russia third with $12,000,000. England's $3,000,000 outlay seems little enough under the circumstances, but even beside that modest sum, the $435,000 that our own Government spent on aircraft pales into insignificance

Abroad, aeronautical research under various governmental auspices had been under way since 1908. Eiffel in Paris, Crocco in Italy, Prandtl in Germany, and the staff of the National Physical Laboratory in England were using already established wind tunnels to acquire much needed data The British Advisory Committee for Aeronautics then had several years of sound work behind it. But up to 1914 there was almost nothing in the way of organized and coordinated aerial experimentation in America. To be sure, there had been some individual effort Langley had set up his whirling arm at Pittsburgh in the 1880's, the Wrights had put in several winters in the early 1900's checking lift and drag in their little wind tunnel at Dayton; concurrently, Dr. Albert Zahm had built a wind tunnel at Catholic University in Washington. But governmental activity was limited to some preliminary work with an experimental tunnel at the Washington Navy Yard

There were those who saw the problem and tried to get some action. Early in 1913 Dr. Charles D Walcott, then secretary of the Smithsonian, proposed

(*Turn to page 134*)

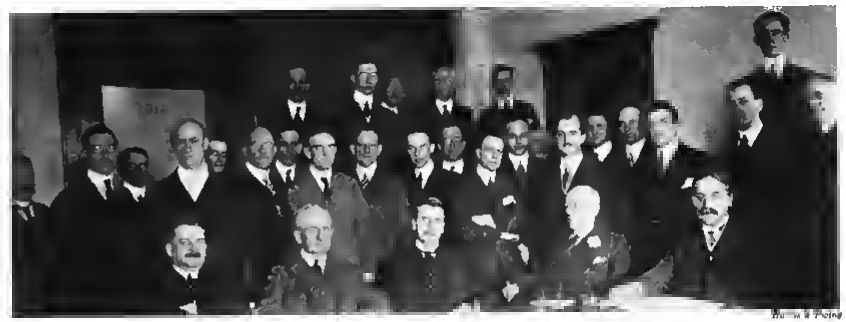
NACA Photo

This JN4-H, borrowed from the Army, was used by Warner and Norton in their early NACA research on flight characteristics of airplanes at Langley Field in 1915. None other than E. T. Allen (now with Boeing) sometimes served as their pilot.

Ed. Warner on his famous motor scooter when he was NACA chief physicist, 1919. This cartoon was presented to him on NACA's 25th anniversary, April 18, 1940.

Harris & Ewing

A noteworthy first meeting was this of the NACA on April 23 1915. Seated, l. to r.: Dr. William F. Durand, Dr. S. W. Stratton, Brig. Gen. George P. Scriven, Dr. C. F. Marvin, Dr. Michael I. Pupin. Standing, l. to r.: Holden C. Richardson, Dr. John F. Hayford, Capt. Mark L. Bristol, Lt. Col. Samuel Reber. Also present at the first meeting were Dr. Joseph S. Ames and Hon. S. R. Newton (then Assistant Secretary of the Treasury).



Harris & Ewing

NACA Executive Committee and Aircraft Mfr's. Assn. meeting in Washington, Mar. 22 1917. Seated, l. to r.: Dr. S. W. Stratton, Dr. Joseph Ames, Rear Admiral D. W. Taylor, Dr. Chas. D. Walcott, Dr. M. I. Pupin. Among those shown here are H. H. Supine, Dr. W. Christmas, B. L. Williams, F. H. Morse, S. G. Weldon, Major Wm. Hutton, A. H. Flint, C. F. Willard, Lieut. J. H. Towers, F. H. Russell, Inglis Uppercu, H. B. Mingle, Edsen Gottraudet, Howard Cottle, Major C. S. Wallace, G. H. Houson, Glenn L. Martin, John DeWyn, John F. Victory. Several other manufacturers were present who cannot be identified in the picture.

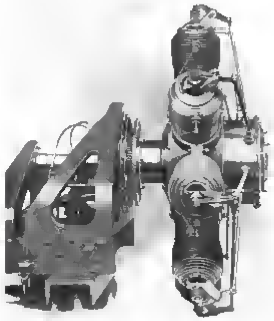
Underwood Photo

On April 21, 1921, l. to r.: J. F. Victory, Dr. M. I. Pupin, Orville Wright, Dr. J. S. Ames, Dr. W. F. Durand, G. W. Lewis, Rear Adm. D. W. Taylor, Maj. T. H. Bane, Dr. C. D. Walcott; Maj. Gen. C. T. Menoher, Capt. W. A. Mellett, Prof. C. F. Marvin, Dr. S. W. Stratton, Prof. John F. Hayford. These men made important contributions to the cause of aeronautics in the U. S.

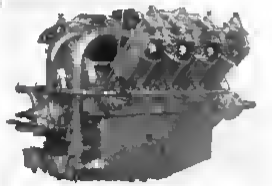
Twenty-Five Years of Engine Development*

From a development viewpoint, 100 years of engine progress has taken place in the past 25 years.

By C. Fayette Taylor
Professor Automotive Engineering, M.I.T.

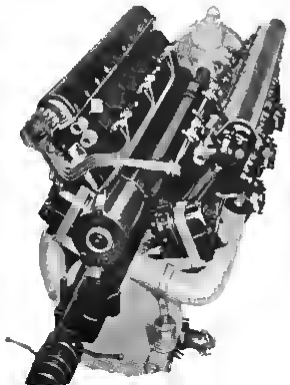


Gnome 'Monosoupape', first engine to have steel cylinders and crankshaft, and a master rod construction similar to today's radials. Developed in 1909.



Curtiss OX-5, widely used to train American and Canadian pilots in 1914-1918.

Hispano-Suiza 8-cyl. V engine. Had composite aluminum and steel cyl construction. Was prototype for liquid engines.



ON AVIATION'S birthday 25 years ago the world situation was very similar to the present one, with a war in Europe and America on the verge of participation. In aviation the situation was also similar in the fact that the most intensive possible development was going on, stimulated by the military importance of the air arm. Technically however, it seems as though a hundred years had passed instead of a mere quarter century, and this is especially true in the field of airplane engines.

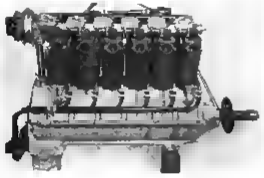
In 1916** the height of American engine development was represented in the Curtiss OX of 90 hp at 1200 r.p.m. with a weight of nearly 300 lbs. This engine would run almost 50 hours without a major overhaul and with not more than one or two forced landings. Its valve gear reminded one of a flock of grasshoppers, and it had the pleasant little habit of dripping water onto the carburetor in cold weather, where it would freeze and stop the engine. After the ensuing forced landing, the ice would have melted by the time the somewhat battered pilot had examined the engine to find nothing apparently the matter. And this was the most reliable American engine of its time and served to train practically all of the Canadian and American pilots for the war of 1914-18.* It is a far cry from this to present airplane engines, ranging up to 2000 hp, weighing only a little more than 1 lb. per horsepower, and running 500 or 600 hours between major overhauls.

A notable difference between 1916 and the present time was the fact that Europe was well ahead of this country in engine development. Pilots over the Western Front had just abandoned the pistol at 50 yards for the machine gun at 150, and pursuit ships were considered extra-powerful at 180 hp. The Allied pursuit ships were powered by Gnome, Le Rhone, and Clerget air cooled radial rotary engines ranging up to 125 hp, except for a few new types which carried the 150 hp. water-cooled 8-cylinder Vee Hispano-Suiza. This latter power plant constitutes one of the landmarks in engine development, for in this engine was pioneered the en-bloc cast-aluminum cylinder construction with steel cylinder liners which is now basic for modern liquid-cooled engines.

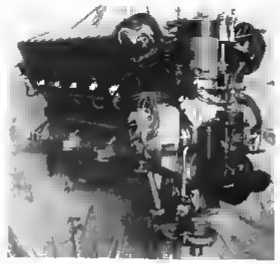
Heavier Allied airplanes were powered with Rolls-Royce, Renault, or Lorraine 12-cylinder V liquid-cooled engines, developing up to 350 hp, and also with the Salmson radial liquid-cooled engine, considered very reliable at that time, and the only one of its type ever to be widely use

* For an historical account of the early years of the aircraft engine see AVIATION for August 16 1930.

** In the short time available for writing this article it has been impossible for the author to verify all the dates and figures involved. Therefore these should be taken as approximate only.



Liberty 12-cyl. V engine of 1918. Was made in large numbers by the U. S. auto industry in an "all out" effort.



Curtiss D-12 of 1923. Its success had great influence on later Rolls-Royce, Mercedes Benz and Allison engines.

German and Austrian aircraft were powered with vertical 6 cylinder liquid-cooled engines of rather conservative rating, most of which developed under 200 hp, apparently with somewhat greater reliability than the Allied power plants. Their weight per horsepower (3 to 4 lbs.) was in general higher than that of the Allied engines.

It was at this time that this country entered into a phase of intensive airplane engine development. This took the form of construction under license of the Hispano-Suiza, the Gnome, and the Le Rhone engines from designs imported from France, together with one original development, that of the Liberty 12-cylinder 45 deg. V water-cooled engine, to be finally rated at 420 hp. at 1700 r.p.m. The story of the design of this engine by three eminent engineers and their assistants locked in a hotel room for several weeks is well-known, but deserves attention here by showing the pace of a real "all out" effort with no thought for "business as usual." Under the circumstances the quality of the engine which resulted was remarkable. Its general construction was copied from that of the German 6 cylinder engines and the English and French 12-cylinder V engines, all of which used the welded-steel cylinder construction pioneered by Mercedes in about 1912. Only a little more than a year after the start of design, it was a remarkable achievement that the Liberty engine had an even chance of passing a 50-hour test at 90 percent rated

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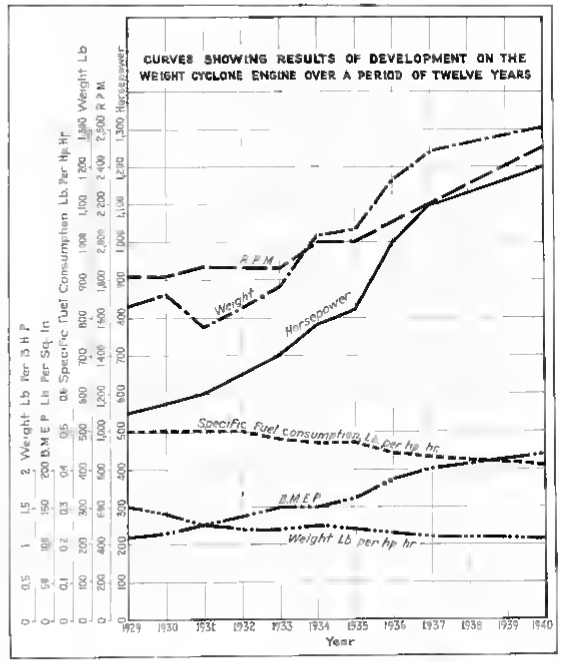
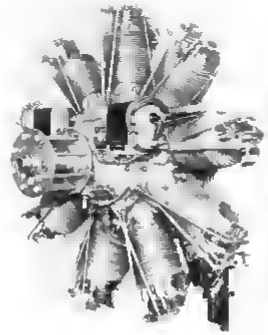
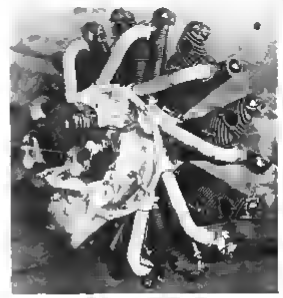
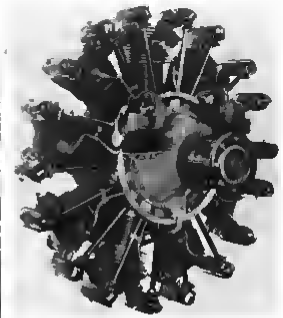




Lawrance J-1, 1924. First U. S. 9 cyl. radial. Many features are still retained.



A Wright J-5 Whirlwind of 1927. This was the engine used by Lindbergh, Chamberlin, Byrd and others. Engine developed 200 hp.



A Pratt and Whitney "Wasp" of about 1927, showing engine mounting lugs and clean arrangement of all accessories. This is a three-quarters rear view. Engine was 9 cylinders and developed 400 hp.

Air Transport Progress Through 25 Years

This is an "I knew them when" article about the airlines and their men, by one who ought to know.

By Fowler W. Barker, *Secretary, Air Transport Association*

REMEMBER Chamberlain's use of a British Airways' Lockheed in his appeasement attempts? That was virtually the end of air transport in England until recently when British Airways started up again with daily service from Britain to Lisbon. Lufthansa is reported to have at least tri-weekly service from Copenhagen and other points to Lisbon; probably there is even more frequent regular service between Germany and German-occupied points.

This has a direct bearing on air transport progress of the last 25 years, for within several weeks of the Armistice in 1918 air transport activity started in Europe. DH-9B's converted into cabin transports, flown by RAF pilots, shuttled Lloyd George and others between London and the peace conferences. Soon such planes were in regular London-Paris service. Similar, but less publicized, air transport attempts were begun in the United States using standard and sometimes modified war-surplus equipment.

Previously, beginning in May 1918, the Army pioneered daily air mail service between Washington and New York using Curtiss JN-4's. This was taken over by the Post Office Department in August 1918, which department, with its subsequent extensions of services (in May 1919 from New York to Chicago, to Omaha a year later, and to San Francisco in September of 1920), became the most important air transport pioneer. There are unsung pioneers who should be mentioned in any chronicle of air transport, particularly when embracing a 25-year period prior to August of 1941. Some designers and fliers (they were usually combined in those days), even before that time contributed to air transport. Robert Fowler's 2,232-mile flight in 151 days in 1912 between San Francisco and Jacksonville certainly contributed to transcontinental air travel. Almost exactly 25 years ago Miss Ruth Law flew the 509 miles from Chicago to Hornell, N. Y.—the forerunner of Chicago-New York non-stops.

The original air travel poster

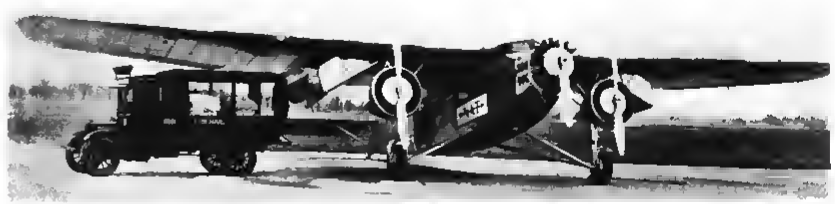
Some of the early strictly air transport services with which the writer was familiar may well be cited, thus avoiding the well known. In the summer of 1920, regular service was conducted for several months between Portland, Astoria and Seaside, Oregon, carrying newspapers and frequently passengers. This was done by the Oregon, Washington, and Idaho Airplane Company which were distributors for and operators of Curtiss surplus equipment. Curtiss Sea Gulls and F Boats were used in this activity; Victor Vernon now Personnel Director of American Airlines, was general manager and Walter Lees, recently of Scintilla and now of the Navy, was one of the pilots. Mr. Vernon was later opecations manager of Colonial Air Transport, operating from Boston to New York. *The Aircraft Year Book of 1921* states that the Oregon outfit contracted with the *Portland Journal* for carrying 300 pounds of newspapers a day and saved 10 hours from train time. The west bound passengers must have been on extra sections, for 300 pounds is about the pay load for the equipment used.

Similar operations undoubtedly existed in other parts of the country—

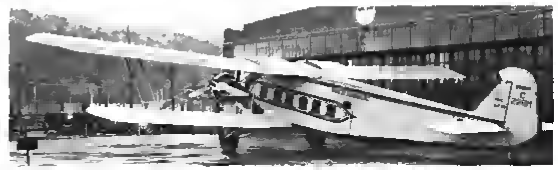
More DH's were flown on the early mail routes than any other plane. This is Jack Knight, now at UAL, with boots and goggles after a mid-west pasture landing.

A J-5 Stearman used by Embry-Riddle on the Atlanta-Ft. Worth California run of what later became the southern division of American Airlines. Time: 1928-30.

In the mid 1920's Curtiss Carrier Pigeons were used on several lines. This one belonged to Natioeal Air Transport, a predecessor division of United Air Lines.



An N.A.T. tri-motored Ford. A great airplane, first used commercially in 1927. Many are still in operation in South America.



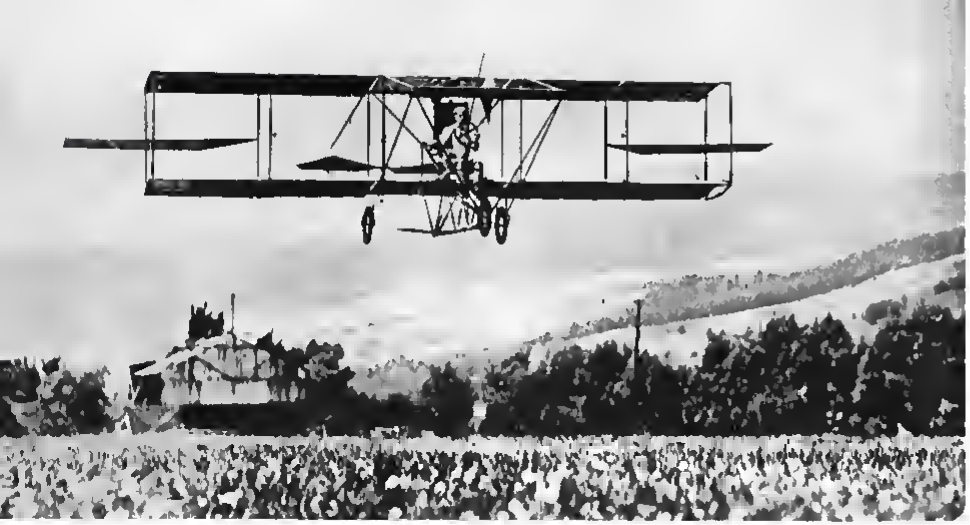
A Boeing trimotor 80-A with three 525 hp Hornet engines. Model 80 was built in 1929, this one slightly later. First used on the Cheyenne-San Francisco run of Boeing Air Transport. 18 passengers or 12 passengers plus cargo was the load.

we know they did in Southern California and Florida—which were really the beginnings in some respects more so than air mail, of air transport as it is today. These operations, even though they did not last long, carried passengers and cargo pre-dating passenger service by air mail operators by at least seven years. It was not until almost ten years later in May 5, 1930 that passenger carriage was general on the part of the air mail operators, for it was then that the first route certificates were issued under the Watres Act which encouraged such passenger carriage.

Aeromarine West Indies Airways, a branch of Mr. Uppercu's sightseeing base at 86th Street and the Hudson

(*Turn to page 170*)

Boeing Mooomail of 1930. A 575 hp. Hornet gave this ship a top speed of 160 m.p.h. This ship was a forerunner of many low wing all metal planes that followed.



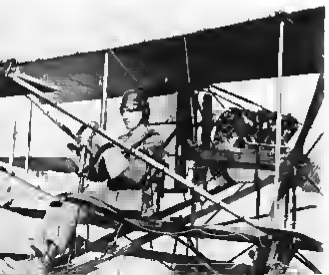
Beckwith Havens piloting a Curtiss pusher in 1911.

Selling Planes in the Old Days

Methods of merchandising airplanes has changed through the years as the airplane itself has improved in usefulness and safety

By Beckwith Havens

As the accompanying photographs indicate, Becky Havens is one of the few old timers still actively engaged in selling airplanes. He learned to fly with Glenn Curtiss in 1911 and was a demonstrator and salesman for Curtiss for a number of years. During the war he was a test pilot for the Navy. He has been actively engaged in aviation for over 30 years and is now distributor for Fairchild at Roosevelt Field, Long Island, New York.



Close up view of the author in a 1911 Curtiss pusher

THE first successful attempt at a sale of an airplane was made by the Wright Brothers when they demonstrated the first powered heavier-than-air aircraft to the Signal Corps of the U. S. Army at Ft. Myer, Virginia, in 1908. In this case the demonstration closed the sale. For the next few years there was no serious effort to merchandise aircraft, though an aircraft show was staged in New York and a few isolated sales were made to pioneer sportsmen fliers like Clifford Harmon, Robert Collier, and Marshall Reid.

By 1910 and '11, a sizable demand for exhibition flights at county and state fairs and carnivals had developed, and most airplanes were built for this purpose. This exhibition flying was in the hands of the two largest companies, Wright and Curtiss, and the flying was done by their own pilots, though in a few cases, airplanes were sold to individuals who booked their exhibitions independently or through the booking offices of the two large companies. During this period Glenn H. Curtiss in an effort to sell airplanes to the U. S. Navy, invited the Navy Department to detail some officers to him for flight training. The Navy accepted this invitation and shortly thereafter Lieut. T. G. Ellyson reported to Curtiss, followed a few months later by Lieut. John H. Towers, now Rear Admiral Towers, Chief of the Bureau of Aeronautics; Lieut. P. N. L. Bellinger, now Rear Admiral Bellinger, and Lieut., now Major B. L. Smith of the Marine Corps. This plan was extremely successful in introducing flying in our Navy, and laid the foundation for the world's greatest Naval Air Service.

Possibly the most serious initial handicap that flying had to overcome was the lack of suitable places to fly from. Curtiss had grown up in the hilly country of western New York, but on the shores of a beautiful lake which, when

frozen, made a splendid landing field. This perhaps influenced Curtiss in his desire to develop an airplane which could take off from and alight on the water. When he accomplished this during the winter of 1911 at North Island, Cal., he opened up a whole new field for the sale of airplanes, as now every river, lake, and harbor was a potential airport.

The float seaplane finally developed into the Curtiss Flying Boat, and Curtiss felt that he had now something which would appeal to sportsmen and the first real effort was made towards sales promotion. A trial advertisement was run in the *Saturday Evening Post* and also in *Life* magazine, and several sportsmen responded to these advertisements and placed orders for the new vehicle. One of the first of these adventurous purchasers was J. B. R. Verplanck of Beacon, N. Y. That year, 1913, an endurance race for seaplanes and flying boats was organized to be flown the thousand miles over the Great Lakes from Chicago to Detroit. Curtiss persuaded Verplanck to enter his new flying boat in this race, and the first time his ship was set up was in Chicago a few days before the start. Curtiss had agreed to supply Verplanck with a professional pilot for the race, and though it took 16 days, by winning this race the Curtiss Flying Boat demonstrated its ability to take considerable punishment and to travel some distance under its own power.

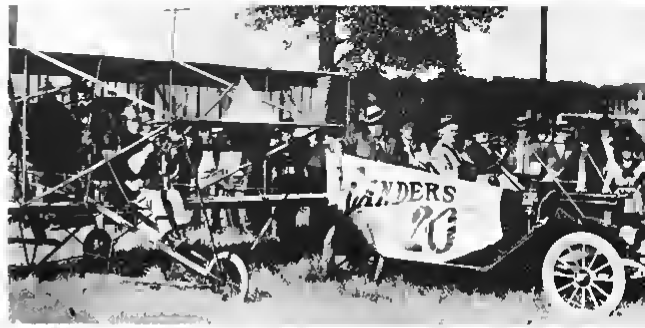
After the finish of the race at Detroit, this flying boat continued on to New York, which constituted the first long distance cruise in a flying boat and was instrumental in producing many more sales, including an immediate purchase by William Scripps of Detroit. Mr. Scripps owned a Wright seaplane which he flew out to meet the winner of the Great Lakes Cruise and tried to follow them in. When he found he could not keep up with the Curtiss Flying Boat, he immediately asked for a demonstration and placed his order. He still maintains that this was the quickest airplane sale ever made.

Now commuting by flying boat was attempted with fair success in several manners including Robert McCormick and Jack Vilas of Chicago, and people began to foresee a practical as well as sporting use for their planes. Anyone watching the activity at the Wall Street ramp can see how well this worked out and what a great success it has been.

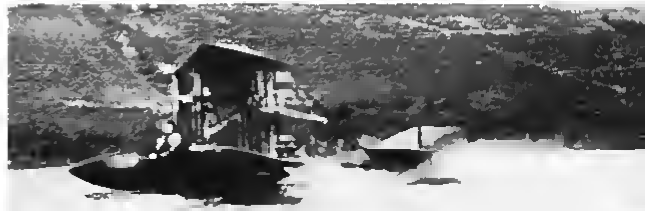
This encouraging start in the sale of

(*Turn to page 176*)

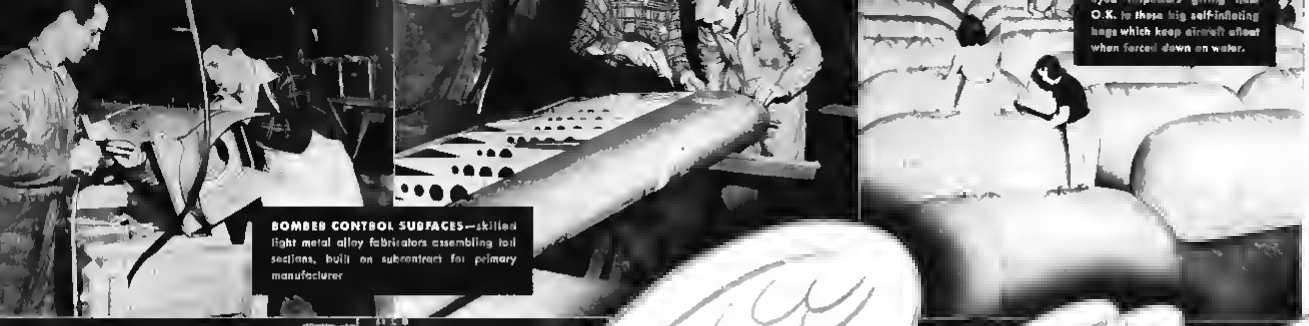
The author just after landing one of the earliest Curtiss pushers mounted on floats



The author in a Curtiss ship at Fort Smith, Ark., Nov. 6, 1911.



Two of the early Curtiss flying boats taxiing and in the air.



BOMBER CONTROL SURFACES—skilled light metal alloy fabricators assembling tail sections, built on subcontract for primary manufacturer

O.K. to these big self-inflating bags which keep aircraft afloat when forced down on water.

BULLET-PUNCTURE-SEALING GAS TANK—veteran rubber worker applying self sealing compound that prevents bullet leaks in airplane gas tank.

RUBBER LIFE BOATS—deft hands give finishing touches to self-inflating life raft carried by military aircraft.

Experience *at your service....*

THE numerous airplane parts and accessories being built today by Goodyear and our subsidiary Goodyear Aircraft Corporation are the products of one thirty years' experience in aeronautical engineering.

Today in our factories skilled workers, under the supervision of men who have been closely associated with aviation since its infancy, are helping to fill the aircraft industry's needs in rapidly accelerating volume.

With this veteran experience, Goodyear has extensive production facilities that make it the leading supplier of high-quality parts and accessories in its field. We are now serving aviation just as we have long served the automobile and motor truck industries, as a dependable mass-producer of rubber and related metal essentials developed out of our long association with all types of transportation.

HYDRAULIC DISC BRAKES—master machinists build this precision equipment with all the accuracy of a fine watch

AIRPLANE TIRES—veteran tire-builders strip Goodyear's 325,000,000th tire from its mold—a giant airplane tire for a four motored bomber

GOODYEAR

SPECIFY GOODYEAR AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

AVIATION Has Showed the Way To Greater Achievement Through the Years

THE conquest of the air has been made possible through the genius and persistence of many men. Unlike other great fields of endeavor it has demanded a combination of physical and intellectual courage in its pioneers. The men and women who were both willing and anxious to push the frontiers of human progress into the third dimension could not afford to make mistakes so they proceeded with great caution. Few people realize how much scientific research went on before the Wright Brothers considered themselves ready to embark on their first history-making flight.

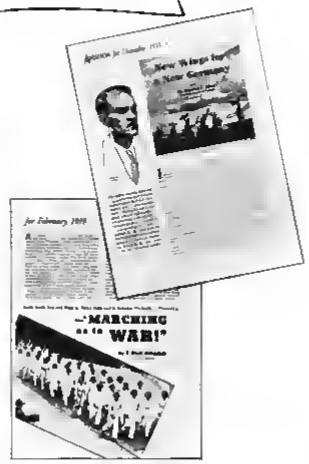
Wherever and whenever sound progress was being made, the editors of AVIATION have been on the job evaluating and reporting achievement in order that each step of accomplishment be made available to all concerned. But the service rendered by AVIATION has gone beyond the appraisal and reportorial function. By thoughtful study of the problems of the several fields of the industry, but complete detachment from any single phase of aviation we have been able to foresee trends and warn against pitfalls. But beyond all else we have striven through the years to persuade our readers that aviation must throw off its cloak of glamour and romance and become a business. Naturally it will always be a business with more than a normal share of fascination. But it will be and it is subject to the basic principles of all business to immutable economic law.

And so in the field of manufacturing we have emphasized research, design, and production. In the transport field we have laid stress on more efficient maintenance, operation and sales. In the airport and fixed base operating branches we have preached endlessly on selling and more selling and how selling is done in other comparable businesses.

As for national defense we have always advocated more rapid strengthening of our air forces. We have gone to great pains to report at first hand to our readers what was going on in Europe through the eye witness accounts of competent observers who were contributors or members of our own editorial staff. And the following pages for example will show that the rapid rise in German air power did not come as a surprise to AVIATION's readers.

The first editorial that appeared in AVIATION twenty-five years ago sets forth our broad policy then and now. We will continue to follow in the footsteps of our founders, subject of course to variation in emphasis to conform with current needs.

On the pages that follow are shown a few of the high spots in our service to the several branches of the industry.



National Defense

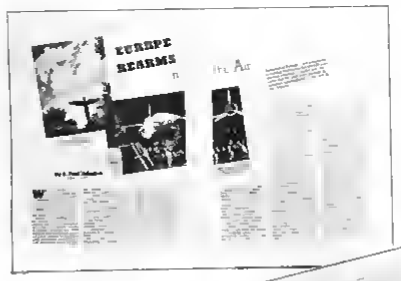
We Cried Out Into the Wilderness

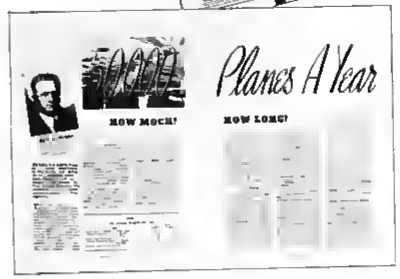
1935— In a series of articles by Edmund T. Allen eminent consulting aeronautical engineer, we told you that "Design and Production of Aircraft in Germany was practically on a War Time Basis."

Said Mr. Allen: "Imagine if you can our own Air Corps, our entire Naval Air Service and the Bureau of Air Commerce rolled into one and multiplied manyfold and you have a picture of Germany's unified Air Ministry. Imagine Wright Field, the Naval Aircraft factory, the National Advisory Committee for Aeronautics and the Bureau of Standards consolidated and you have something like the present German D.V.L. (Deutsche Versuchsanstalt fur Luftfahrt). Imagine finally a sort of Super-Institute of the Aeronautical Sciences with technical sub-committees headed up by the best known aeronautical names in the country, not only performing its own research and development in every line of aeronautical activity but coordinating all other agencies, acting as a clearing house for development work, allotting funds for specific research projects to any agency that seems best equipped for it, eliminating duplication of efforts in all departments, and you have some conception of the enormous Vereinigung fur Luftfahrtforschung (formed two years ago by Air Minister Hermann Goering), popularly known as the V.L.F.

'Back up this vast system of a dominating bureaucracy with an unbelievable enthusiasm for matters aeronautical shared by the military and the civil population alike, and you have some idea of what aviation has come to mean to the New Germany. There, things are coming true which might seem to us in America as the dreams of a distant future. Nothing seems impossible to Germany's aviation planners. All differences have been swept aside and all factions have been united. Germany now has an Air Ministry as efficiently centralized as Mussolini's own, but made more efficient, perhaps, by Prussian genius for organization and Teutonic capacity for taking infinite pains over the smallest detail. We find a public suddenly awakened to the future of aviation suddenly determined to build a new and greater nation of flying men and air-borne commerce.'

1937— After a trip to Europe S. Paul Johnston, then editor of AVIATION, said:





"The present combined service strength of our air forces is well under 2,000 machines. In contrast Germany alone at the present time has an air force estimated in the neighborhood of 7,000 machines of all types and a probable production rate of close to 10,000 a year. Considering Europe as a whole it seems reasonable to suspect that aircraft production overseas is in our aircraft production as our automobile production is to Europe's motor car output.

"Thus the great armament race that is going on in Europe has taken on a new complexion. Land and naval forces are still of great importance in tactical plans and much money and effort is being spent to improve them. Ground forces are being mechanized to the limit and battleships are being studied closely for improved efficiency but the real race is in the air for the rise of air power has upset all of the classical military concepts. It has also changed many diplomatic concepts for international alliances need no longer be based upon the geographical proximity of the contracting parties. The high speed and long range fighting power of aircraft has changed that picture." Prophetic, wasn't it?

1939— The Fall of France and the superiority of Nazi air power were foreshadowed in another article by Mr. Johnston, following a trip to Europe in 1938. We reproduce here his rating of the relative air strength of the major nations.

	Germany	Soviet Union*	Italy	Great Britain	France	United States
Airplanes (incl. reserves)	10	10	5	3	2	5
Quality	10	5	8	6	4	10
Production rate	10	7	4	4	1	2
Production cap'y †	10	8	6	6	3	4
Personnel	10	10	6	3	3	2
Morale	10	8	6	8	2	8
Total points	60	48	36	30	15	27
Rating	10	7.6	3.3	5	2.5	4.5

*Based on available information not on personal observation.
† Within bounds of present aeronautical industry in each case.

1940— When the President asked for 50,000 airplanes we were able to give you an estimate of the cost in money, time, and factory expansion in a brilliant analysis by T. P. Wright, world authority on aircraft manufacturing and now Assistant Chief, Aeronautical Section, O.P.M. This was one of a series of four articles by Mr. Wright on the productive capacity and expansion of our aircraft industry and the relative air strength of the contending countries.

1941— When criticism fell upon the aviation industry because production was slow in coming, AVIATION stated the reasons and a competent, realistic estimate of what progress might be expected in "The Truth About the Defense Program," by T. P. Wright.

Engineering Research Production

1916— In the beginning there was no course in aerodynamics and airplane design. AVIATION corrected this situation in its very first issue.

1928— When the federal government first required a stress analysis of every airplane, there were many of the old-time empirical designers who found themselves in deep water. We published a series of articles on Stress Analysis and how to do it which met with wide acclaim.

1929— When aeronautical engineers wanted a place apart in which to exchange ideas we instituted "Aeronautical Engineering" in 1929. Among the brilliant contributions was a series on the design of "High Altitude Airplane" by B. V. Korvin-Kroukowsky which foreshadowed the design of the stratosphere airplanes of today and tomorrow.

1929— When the exhaustive research on radial engine cowling by the N.A.C.A., was in its infancy, AVIATION first told the story to aircraft designers in a series of articles by Fred E. Weick.

1930— When engineers were clamoring for perspective sketches of design details, we were the first publication in this country to provide them at considerable expense.

1936— When production became the watchword, we provided an increased proportion of this type of material for our readers, and have been furnishing increasing quantities of this type of material ever since.

1941— Our production issue in June furnished a complete story on industry expansion and manufacturing progress to date.

Air Transportation

1931— When airline maintenance methods were shrouded in professional secrecy, we were able to show the operators that there was more to be gained by exchanging ideas than by keeping them to themselves. Result: AVIATION's "Maintenance Notebook" and many articles on the best in maintenance methods.

1933— When flying the Atlantic was a dangerous stunt, Roger Q. Williams predicted the present-day routes in an article entitled "Transatlantic Air Lanes" in AVIATION for July, 1933.

1934— When schedule keeping and operating efficiency became a necessity in airline operation we were the first to publish an extensive series of articles on cruising control by Edmund T. Allen and W. Bailey Oswald. This method is the basis on which airline operation is conducted today.

1939— On the eve of the first scheduled operation across the Atlantic, we published a round-up of the background of the service in the March, 1939 issue.

1940— When commercial aviation began to be eclipsed by the military, we presented a brilliant analysis of where we were and where we were going in the air transport business by T. P. Wright.

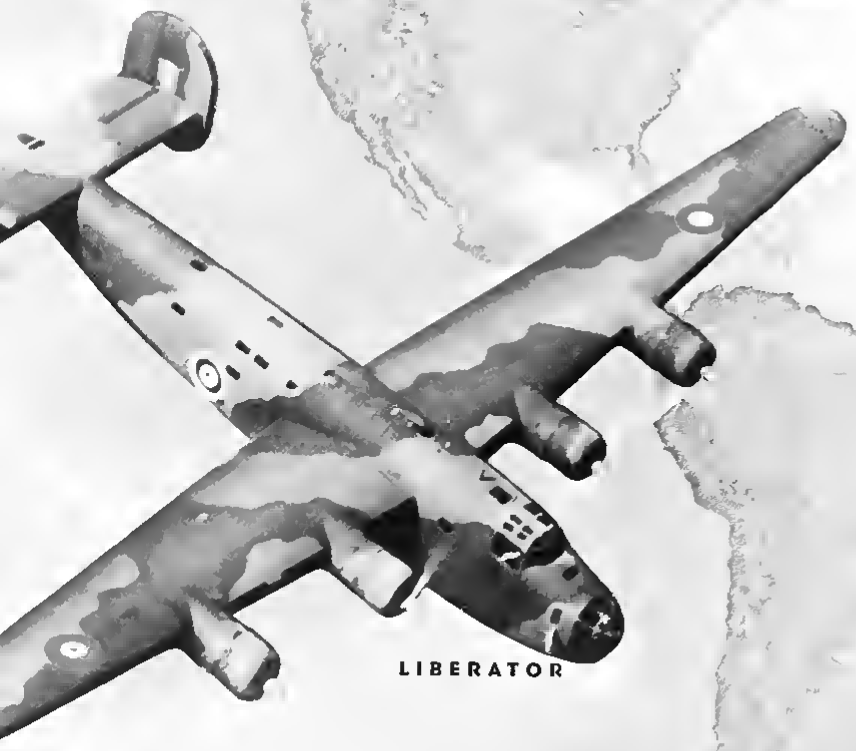
Airports And Fixed Base Operation

1935— During the dark days of the lean years of fixed base operation we spread the gospel of placing aviation sales and miscellaneous service on a sound business basis in order that it could survive. The operators who had

(Turn to page 234)

"ALL OUT" for the Democracies!

CATALINA



LIBERATOR

B-24

PBY

Completion of **Consolidated's** new Parts Manufacturing Plant in San Diego enlarges facilities to twenty-four times those of the original factory, built in 1935 when the Company moved from Buffalo, New York.

It's **"all out" at Consolidated now** with performance in mass production of giant multi-motored land and sea bombers as amazing as the high performance of the planes themselves.

CONSOLIDATED
Aircraft CORPORATION
ESTABLISHED 1923
SAN DIEGO, CALIFORNIA

LET'S GO! U.S.A.
KEEP 'EM FLYING!

Condors and Humming Birds

The confidential, inside facts on why the West Coast became the Promised Land for airplane manufacturers—told by our Pacific Coast Editor, who is a third-generation, dyed-in-the-wool Californian

By Charles F. McReynolds

SUN baked beauties of the Hollywood movie colony don't bother their pretty heads much about the antecedents of the man-birds which so frequently cause "re-takes" these days. For airplanes are a major source of annoyance to picture studios when the roar of a Flying Fortress or Stratoliner, or the put-put of a private plane, insinuates itself onto the sound-track of a pre-Pilgrim days picture.

But to us of the aviation industry there is considerable cause for wonder at the astonishing development of aeronautics in an area whose chief claim to consideration was an abundance of sand, sagebrush, and rattlesnakes. Along the shores of the Pacific Coast and especially in Southern California, has grown up the greatest concentration of aircraft manufacturing activity in the world. Yet this Pacific Coast country has been until recently relatively sparsely populated and undeveloped. Remotely situated and separated from the industrial East by vast plains, deserts, and rugged mountain chains, the Pacific Coast has suffered from transportation difficulties, lack of secondary industries, and a general shortage of skilled labor. There are other reasons why it should not be the great aviation center which it is, not the least of which is that the terrain, being mostly up and down, is about the worst flying country in the world. Yet there are more planes and more pilots in California than in any other state of the country.

It may come as a shock to good Bostonians to learn that California was first explored in 1542, almost a century before the Pilgrim Fathers landed on Pilgrim Rock. But the region remained relatively unpopular until 1849, when the famous Gold Rush brought a tremendous influx of people seeking easy money the hard way. No doubt all of these people would have preferred to fly across the Indian country rather than to cruise through it in ox-drawn Conestoga wagons which served as an irresistible target for the arrows of the sports minded gentry of the feathered clans. Perhaps this yearning to fly from danger helped inspire the development of aviation later.

One thing is certain. The development of aviation in California cannot be explained on material grounds. Concentration of aircraft building in that section has been credited variously to the superior climate, the abundant cheap electric power, the favorable labor conditions, etc. But in view of the many disadvantages which would normally greatly outweigh these points it must be concluded that there is a deeper reason for this development.

It must be significant that Southern California is the only place in the world where the great Condor, the world's largest bird; the humming bird, called the swiftest thing on wings; and the golden eagle, symbol of bravery, all are found. So this same country which shelters these extremes in feathered kind has proved a natural breeding place for the P-38, the B-19, the Mustang, the Vengeance, and all the other man-birds who have hatched here to spread their wings across and around the world. It must be more than mere coincidence that from Southern California have come the planes that were first around the world, and the plane that was fastest around the world, the planes that were adopted as standard on almost all the airlines of the world.

If we cannot explain the pre-eminence of the Pacific Coast in aeronautical affairs from a material angle, then there is a spiritual explanation at hand, and a good one. For the one thing that the people of the Pacific Coast have above all other people is the spirit of pioneering. As America has been built by pioneers, men and women who sought always to reach new frontiers, so we must rank the settlers of the Pacific Coast as people of a super-pioneering

(*Turn to page 178*)

The B & W Trainer was the first Boeing product, in 1916. It had a 4-cyl. engine and a top speed of about 65 m.p.h. Plenty of wire is evident.

Office of the Boeing Company in 1917.

A 1924 scene at Boeing, when 150 DeHavil lands were being remodeled for the Army.

Ancestor to the famous Boeing Clippers is this PB-1, 12 ton boat built in 1924-25. Power plant is twin Packard 800's in tandem. It was built for the Navy.

Allan and Malcolm Loughead with the mighty flying boat they built in 1918. Ship had two Hall Scott engines of about 150 hp. each. These brothers were the founders of the now famous Lockheed organization.

Claude Ryan in 1921 when he was using a DH on forest fire patrol in California.

BUILD WITH STEELS THAT HAVE EARNED THEIR WINGS

HERE are alloy steels preeminently fitted to take the shock loads in landing gears—to withstand fatigue in engine mounts — to carry the stresses concentrated in many vital points in primary aircraft structures.

More than high strength-volume ratio distinguishes the U·S·S Carilloy Alloy Steels that have received the "AC" — *Aircraft Quality* — stamp.

To earn this "AC" rating, the steel not only receives very special care in every phase of manufacture, but must run the gauntlet of stringent tests and inspections that prove its ability to meet the high requirements of aircraft manufacture.

Only steel that has passed these searching examinations is accorded this "AC" stamp—the identifying symbol that on U·S·S Carilloy Alloy bars and billets says in effect "Here is *aircraft quality* steel on which you can confidently rely."

U·S·S CARILLOY ALLOY STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

TWENTY-FIVE YEARS OF SERVICE TO THE INDUSTRY

Twenty-Five Years of Airports

It's a long way back to the meadow and prairie landing fields of 1916, when any flat field was an airport.

By Emil K. Harvey *Airport Director, Haller Engineering Associates, Inc*

Opening day at the Curtiss Flying Field Garden City, Long Island May 15 1921. Grass runways were the order of the day.

"COME, let us motor out to the aircraft station or aerial garage where they have land and water alighting facilities" This would have been correct phraseology a quarter of a century ago, but in this modern hour of blitzkrieg the statement is a little grotesque.

We have changed Flying has shed that adventurous stage and become a serious science. But what of the flying field?

To the pilot of today, those fields at their best would have appeared a little more than a good size meadow, rough and dusty with a poor grade of grass if any There might have been a row of high-gabled frame buildings along one side. There probably was some sort of wind direction indicator, but no surfaced runways, no lighting, no traffic control to worry about, and no weather bulletins Just a field That was all that was needed It suited the age of the duster, goggles and cap A step ahead of the horse-and-buggy days

People traveled far to the flying field, expecting to witness a spectacle and they did Accompanying it were all the inconveniences imaginable, but who cared? They were there to fly or watch others fly Their whole interest centered on the aeroplane and on construction the flier

Little thought was given to the selection of the site The cheapest, flattest land was probably the determining factor It came about that way and stayed. Flying increased and machines improved, but the field remained the same

The first World War created a demand for additional training centers As time passes this did not last long When hostilities were over military flying was curtailed and many of the fields went into the discard

However, the flying field found other excuses to exist Air mail though still in the experimental stage was rapidly taking shape Here and there additional hangars were needed with something of an office in the lean-to Homemade boundary markers painted white began to appear, after numerous complaints and a few threats from the farmer next door Anything answered to indicate to the incoming pilot the extent and peculiar shape of the field.

It took a few nose overs and bogged down planes before artificial drainage was resorted to Even then it was a slow process Planes would fly as long as the pilot could see the ground but things happened when he reached a muddy field after a storm two, three, four and even twenty-four hours prior "The mails must go through" did not exempt this new form of service Paved runways with drains along the sides were never thought of and if they were, who was going to pay for them?

With the gradual shaping up of the field there was one factor that did not change, *proximity!* Although showing signs of improvement it is still the bugaboo in air transportation Far away in the outskirts even beyond what might be called the suburbs by a stretch of the imagination, were located these air mail fields we are talking about

American Airlines photo

The new Washington Airport is an example of a completely equipped, modern field. With clear approaches and long runways it is a pilot's Utopia

It took 45 minutes by fast train to the country's greatest metropolis after more than an hour had been spent transferring the sacks of mail from the field to the railroad station via truck An accepted practice until 1930 Today air mail is landed at a field within the city limits, but to travel out there by acceptable means costs a dollar flat, before you even get your feet off the ground

Along about 1920-21 considerable interest was stirred up over landing fields Although still answering to queer names the aircraft station became an object of concern

At a meeting of the National Safety Council an aeronautics program was outlined It was suggested that landing fields were "to be handled by the Aero Club of America" which would "try to induce city councils to make at least one landing field in each city" This was an ambitious program that in a way, is still in progress under different agencies.

It was the result of this endeavor that most likely prompted the report that the Hotel Astor, New York, was planning a landing field on the roof It was to be "62 feet wide by 286 feet long with special service for aeroplane guests"

To fly from house tops has long been a fantastic idea. As advantageous as this might be to land planes at one's back door, it was not until 1939 that roof landings were actually practiced and then with an autogiro

A roof specially prepared for this service was incorporated in the design of the Philadelphia Post Office For about a year ending June 20th, 1940 mail was shuttled between the post office and Camden Airport, using autogiros

The early flier was quite aware of the shortcomings of his plane and was continuously alert to the possibilities of engine failure Forced landings were not rare and to overcome the definite lack of designated landing fields, it was imperative that landing speeds be slow (25 to 35 m.p.h.) requiring little space in such emergencies

The plane designer had different notions Speed was the salvation to aviation so up went the landing speeds There was only one answer, build larger fields and more of them Always has the airplane predicated the airport

There was considerable flying field advertising which more than likely prompted the aerial garage idea

An Eastern Air Lines Kellett autogiro taking off from the roof of the Philadelphia post office.

Among other attractions, available mechanical assistance was featured not too far from the field in a garage only three-quarters of a mile down the road

After a few courageous air mail pilots proved to Congress the feasibility of night flying things began to happen fast Beacons were erected on the fields and lights added to the homemade boundary markers Red obstruction lights were placed on adjoining buildings and floodlighting the landing area was experimented with Sufficient illumination of uniform intensity distributed over an amazing area, was derived from a single unit in the form of a carbon arch behind a parabolic lens This was followed by a battery of incandescent lights and finally to the individual runway floodlights of today

Attempts were made to control floodlighting automatically by adjusting a sensitive switch to the pitch of a siren on the plane There was an economic merit in this device until a passing motorcycle police siren affected the switch in broad daylight

The fundamentals of airport design really began to come into their own after the establishment of the Aeronautics Branch of the Department of Commerce in 1926 The airport division of the Branch published recommendations for various classes of airports. Runway and landing strip were described, but still of the turf variety indicated at the ends by green approach lights

To obtain the highest rating in size it was required that the field permit landing in at least eight directions at all times, with clear approaches The strips were to be 500 feet wide and at least 2500 feet long. This stipulation

(*Turn to page 168*)

Twenty-five Years Of Progress in Materials

The Army has done a man-sized job in testing and using new materials.

By J. B. Johnson, *Chief, Materials Laboratory, Wright Field*

THE *Specifications for Military Airplanes* issued by the Chief Signal Officer of the U. S. Army in the Spring of 1916 for the purchase of military airplanes was one of the first documents which contained detailed requirements on the fabrication of airframes. There were no specific specifications for materials. The control over quality was exercised by observations made by the Army Inspectors, governed by the following stipulations:

To require supplementary tests as desired of materials and parts when deemed advisable.

To see that steel used in construction will be of such a grade as to have high resistance to crystallization due to vibration.

The use of such other materials as have not been proved by test or experience to be non-subject to crystallization due to vibration will be discouraged.

To see that provisions for the protection of metal parts and adjoining wooden parts against the corroding action of salt water and moist air are satisfactory.

If laminated wood parts be used, to see that provisions for protecting them against the action of salt water, vibration, etc., are satisfactory. Particular care shall have been exercised to prevent access of moisture at faying surfaces to end grain butts scarfs and joints and such protection must be applied before the final assembly of parts.

The wing covering to be of the best grade of raw linen of weight not less than 3.75 ounces per square yard. The method of covering the wing to be such as to render the cloth of the proper tautness smoothness and security. Holes about $\frac{1}{8}$ of an inch in diameter with rust proof eyelets shall be placed between each rib near the inner rib in each case on the lower surface of the wing about 1.5 inches from the trailing edge.

The color scheme will be as nearly white as practicable, using standard dopes and varnishes.

Stranded steel cable will be used for all tension members which are readily accessible for adjustment and for all control leads.

The material and method of tipping propellers will be such as to insure protection against the action of sand spray as well as to render the tips secure in place.

All gasoline tubing to be satisfactory as to flexibility, durability, impenetrability and to have been tested for leaks after vibration.

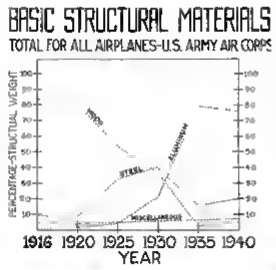
It will be considered desirable to have provision in the gasoline tank system for reducing to a minimum loss of gasoline due to bullet holes.

Data showing the elastic limit, hardness and other important physical characteristics from authenticated records of tests on the exact steels (exact including final heat treatment if any) used in the construction of the various parts.

Reliable historical information regarding the origin and time and method of seasoning of the material for wooden parts.

Records of tests of glue, cement, shel-

(*Turn to page 198*)



As early static test of a multi-spar metal wing at Wright Field.

BREWSTER BUFFALOS at Singapore are the first sight to welcome incoming friendly ships of sea or air, or to warn invaders of the British defense ring in those far-off seas. Squadrons of Brewsters, already at Singapore, are the vanguard of protection flowing from American aircraft factories not only to strengthen Britain at home, but also to defend the farthest-flung possessions of the British Empire.

Brewster

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Active head of Turner Aviation Institute is Col. Roscoe Turner, three-time winner of the Thompson trophy and internationally famous flyer. Active since 1912, Col. Turner holds many records both for speed and cross country flying. In addition to the Thompson trophy, Turner won twice winner of the Harmon trophy and a three time Henderson trophy winner. He was awarded the American Legion Goddess of Victory trophy as the outstanding flyer of 1930.

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- ☐ Private Pilot Course
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- ☐ Flight Instructor Course
- ☐ Aerobatic Flight Training
- ☐ Instrument Flight Course
- ☐ Link Trainer

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AVIATION INSTITUTE

Roscoe Turner Aeronautical Corp.

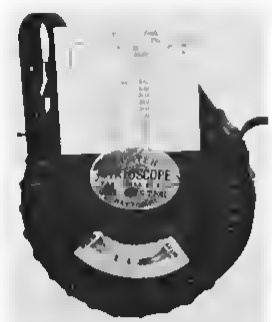
Filling Up the Instrument Panel

Early airplanes had no instruments at all. Now a large transport has them by the score. This is a brief but interesting story of the development of aircraft instruments.

By Mortimer F. Bates
Sperry Gyroscope Company

TWENTY-FIVE years ago the background of world events was much the same as it is today. The year 1916 ushered in the first expansion program in the United States of the infant aeronautic industry. The engine builder, the airplane builder, and accessories manufacturer were relatively as busy then as the present greater industry is now. The major difference today is in the great technical advances that have been made since that date bringing into really higher speeds and large multi-engined ships.

Only seven years before that nile-



The first form of a rate of climb meter, originally developed by L. L. Coster for balloonists. Custer is now a toy manufacturer in Dayton.

A modern type of rate of climb, made by Kollsman.

posal our War Department bought its first military airplane, a "Wright Flyer." The need for flight instruments had barely made itself felt. The fliers then obtained their information by direct observation as best they could. At some time or another you have heard reference made to pre-instrument flying as flying by the "seat of the pants." This is an expression coined *after* instrument flying had become a fact. We flew by the feel of the wind in our face by our eyes, and the visible horizon. The only acceleration that was of great concern to us was the sense of gathering speed that would take our machine into the air.

That first Army "Wright Flyer" had no flight instruments. There was no engine throttle or mixture control. The ignition could be retarded or advanced and the engine compression released by a device to hold the exhaust valves open. With simple gauge glasses on the oil sump and gas tank, the picture of that early date is complete.

One of the first Sperry aircraft compasses, believed to be the first eye level compass for airplanes. It had many advantages over the bowl-type compass, which was usually set in the floor. Time: 1914-1915.

A modern Pioneer compass for flush mounting with good illumination, and a built in compensating device.

Original production model of a Sperry turn indicator. First aircraft turn indicator developed 1916-1918. Also this was first gyroscopic device for panel instrument mounting. This was a basic instrument in 1918 and is still a basic instrument. It was taken over by Pioneer in the early 20s.

A modern Pioneer turn and bank. The ball bank feature and other refinements have been added.

The simulation of wartime demand for airplane instruments 25 years ago spurred the research worker, the designer, and the inventor on to finding better answers to the basic questions the pilots were asking when in flight—which way is North? How high am I? What is my ground speed and drift?

Engine instruments were fairly well defined by that year. The early flyer was "engine conscious." He wanted answers to two questions before he would assay a flight—how many r.p.m.'s does the engine make? and, with the propeller how many pounds pull does it give on a spring balance?

This brings us to the three divisions of aircraft instruments: power plant or engine instruments, flight instruments and auxiliary instruments.

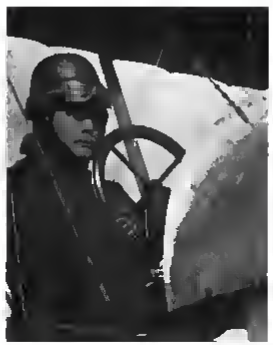
Because of the sharp uptrend in horse power at the time I write of, the spring balance check had fallen into disuse. It is interesting to note here that only within the last few years has this spring balance check on the engine been revived in another form that gives horse power in flight. This is an experimental instrument known as a horse power or torque meter that measures propeller shaft reaction at the engine mount.

Engine tachometers of that day were of three types, all driven directly from the engine by a small flexible shaft like a dental drill, as follows:

1. The eddy current or magnetic drag type, represented by Warner, where a magnetized split steel ring is revolved freely within an aluminum drum restrained by a hair spring. The drum winds up on the hair spring in proportion to the speed of the magnet, therefore the drum properly marked will indicate r.p.m.'s.

2. The fly-ball governor type, represented by Jones, where the spring-restrained governor weights raise a collar on the central shaft in proportion

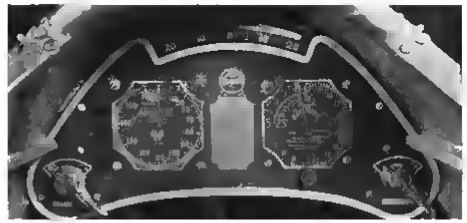
(*Turn to page 192*)



The author in the Alexander Langley air plane he built in 1913.

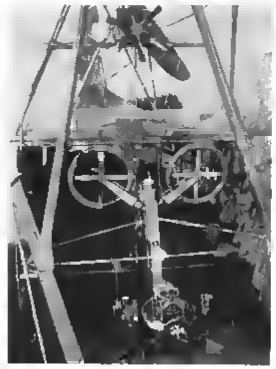
Mr. Bates started his aviation career working on motor assembly and test with the Wright Brothers in their bicycle shop in Dayton, Ohio in 1906. In 1911 he made a barnstorming tour in the vicinity of New Orleans and that same year entered the Moisant School in Mineola. He received his F.A.I. Certificate (Number 68) after passing flight tests on October 15, 1911. Later he had charge of the Moisant Factory, making Blériot pieces at Winfield, Long Island. In 1912 while still with Moisant he went to Hammondsport for training on Curtiss Flying Boats and it was there that he had his first contact with Lawrence Sperry. After building a special ship for Mr. Alexander Laughlin, Jr. of Pittsburgh in 1913, he joined the Sperry Gyroscope Company in October of that year.

Mr. Bates worked with Lawrence Sperry on the development of the Aeroplane Stabilizer and made the first Navy Gyropilot installations at Pensacola in 1915. He continued close association with the development of successful instruments both here and abroad, from the earliest days makes him one of the few men in the United States qualified to discuss them. He has seen the instrument panel grow from a marine type magnetic compass and a piece of string to the mess of the modern transport panel and to the integration and separation of groups of essential instruments now under way in the larger transport and military types building today.

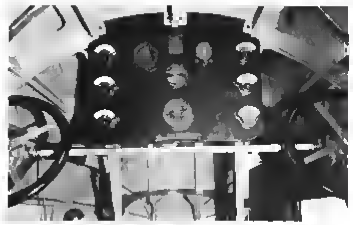


A primitive instrument board in a Johnson Aircraft "Twin 90." At top of panel is an early lateral spirit level. At left is an early air speed indicator and at right an early altimeter.

A modern Kollsman sensitive altimeter with setting markers and barometric scale.



Production model of the first Sperry airplane stabilizer mounted in a Curtiss flying boat in which Lawrence Sperry broke endurance and distance records in 1914. The stabilizer is shown in the foreground.



Instrument panel of the 1923 Barling bomber. With six engines it was comparable in size with large ships of today, yet note the scarcity of instruments. In vertical rows on each side are the six electrically operated engine revolution counters. Upper left cooler is an oil meter, upper right center a clock. In center is a Sperry turn indicator and below it an air speed meter. Lower center a spirit level.

Instrument panel of a twin Liberty Curtiss F5L built for the Navy in 1919. At extreme left, behind wheel and lower left of wheel are two Sperry Creagh Osborne compasses. On instrument panel, L. to r., are a clock, oil pressure gauge tachometer, altimeter, air speed indicator, a second tachometer and oil pressure gauge. Behind right wheel is a bubble spirit level.

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Twenty-Five Years of Gliding

With the new military emphasis on gliding, the importance of this phase of flight is finally recognized. But soaring has had many lean years in its history.

By Sherman P. Voorhees *Co-Founder of the Soaring Society of America*

TWENTY-FIVE YEARS of gliding history is but a small segment of the total. It is an important segment for two reasons; first, the interest which has been focused on gliding by the use of this means of flying in the Cretean campaign (by the Germans), and secondly, because this span covers the important years of the development of American motorless flight.

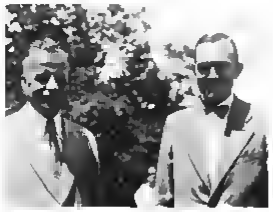
Before proceeding further, let it be said the Germans, restricted in aviation activity by the Treaty of Versailles, cleverly built up their glider activity as a means of teaching flying, but with exceeding shrewdness called it a sport. To the world which did not see through this subterfuge, it was very, very clever. England, Belgium, Italy, the U. S., other countries fell for the "sport" angle as the pins before a bowling ball.

In America, this held particularly true. The writer has culled through countless clippings on gliding and soaring from 1926 to date and noted that writers placed emphasis on gliding as a sport. Not the Germans. Not the Russians. These literal and analytically minded peoples saw the value as a source of fundamental flight training—the machines as a potential type of troop carrier. We Americans coasted along and viewed this form of flying as a sport.

It is true the Navy tried out an experiment in glider flying as a source of primary flight training. The Army, long reluctant to go into the matter, sent flyers to be trained in Lockport, Ill., and Elmira, N. Y.

Further glider training for Air Corps pilots is expected in the immediate future. One sailplane (a Schweizer) has been delivered and others ordered.

Speaking at the closing banquet of the 12th annual National Soaring Contest, Major General Henry H. Arnold stated the Army was purchasing several types of gliders ranging from the 2-place ships to 15-place models. Such support from the Army is most encouraging.



Two men who have done a great deal for American soaring. Left the late Warren Eaton, first president of the Soaring Society, and right, Sherman P. Voorhees.

The trophy presented annually by Aviation magazine for the most outstanding sailplane design. This year it was won by the Crowe City Glider Club of Pasadena for the "Screamin' Weiner" on opposite page

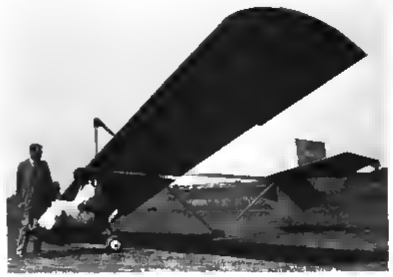
Let's go back a way and trace the rather irregular pattern of glider development as non-service activity. Irregularity characterizes the pattern—but let it be said both factually and honestly—that enthusiasm will carry through and over barriers where well-ordered effort may fail. There has to be a first time, there must be a beginning; so it was in 1928 when J. C. Penny, Jr., first brought to this country the three German pilots headed by Capt. Paul Franz Rhoere. It was on Cape Cod where the motorless craft demonstrated its potential value, but it was not 1928, but 1930, before this demonstration began to receive public attention. After the demonstrations of Capt. Rhoere and his companions, Mr. Penny's enthusiasm for gliding was fired.

In 1929, Edward S. Evans, of Detroit, started the National Glider Association. This organization under the active management of Donald F. Walker, began to publicize the possibilities of motorless flight. Glider clubs began to be formed throughout the country and most of them affiliated with the National Glider Association.

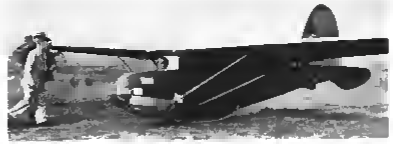
In 1930, the Association had completed its topographical surveys and determined upon Elmira, N. Y., as a logical site for a national contest. In September of 1930 the first contest was held. From then on Elmira became the scene of the Annual National Gliding and Soaring Contests. As time went on, facilities began to improve until today the now famous Harris Hill provides unexcelled facilities, administration building, cabins for contestants, swimming pool, and two hangars.

No better example of the progress of gliding and soaring at the national contests can be made than the fact that in the first contest in 1930 the altitude mark set was 2,128 feet, while in 1939 an altitude of 17,264 feet was achieved. In 1930, the prize for distance was given for a flight of 21 miles, while in 1940, John Robinson flew 290 miles.

(*Turn to page* 204)



A primary type glider used for instruction at the Chicago Gliding School at the Curtiss-Reynolds airport in 1933



A utility glider being landed by W. H. Franklin at Ypsilanti, Mich. at the Cleveland Air Races in 1929. This glider was towed behind a Waco and cut loose at 2500 feet.

Fred Loomis

The "Screamin' Weiner", winner of the 1941 Aviation Magazine trophy at Elmira. Ship was designed and built by the Crown City Club of Pasadena and flown by Frank Boggs.

Dr. Frank Gross and his four-place glider

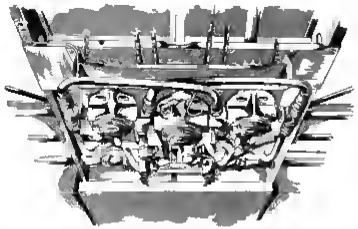
Air Corps' first glider being assembled last month at Elmira.

Acme

Fred Loomis

Scene at Elmira during 12th National Soaring Contest, 1941

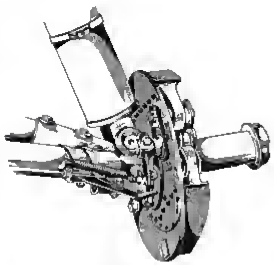
Elmira in 1931 with a line-up of gliders.



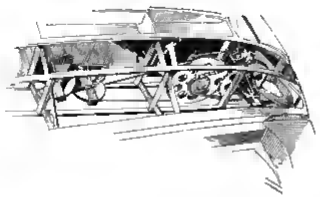
"The remotely controlled gasoline valves used in the fuel system of the Curtiss "Condor" sketched from beneath the fuselage"—June 1939

AVIATION SKETCH BOOK OF DESIGN DETAIL

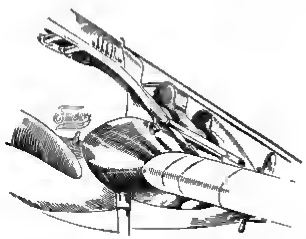
One of the important developments in AVIATION's history was the use of perspective cutaway drawings and sketches to illustrate the latest in engineering design. Many have thought that this type of presentation is rather new—actually AVIATION was pioneering in this in its early years. Here are some of the sketches taken from issues ten to fifteen years back—along with some of the present day material, showing interesting trends.



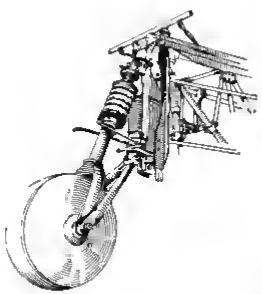
'Sketch showing the wheel brake and actuating mechanism of the Consolidated Fleetster"—April, 1930.



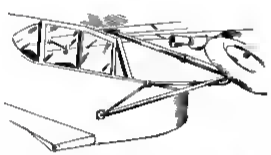
"Sketch of a portion of the uncovered wing of the Curtiss Tanager showing operating mechanism for the floating aileron"—February, 1930.



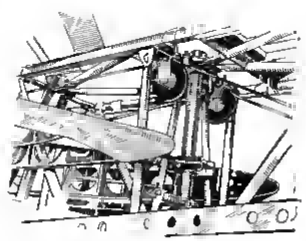
'A sketch showing ample fillets housing fuel tanks of the Emsco Cirrus low wing monoplane"—September, 1929



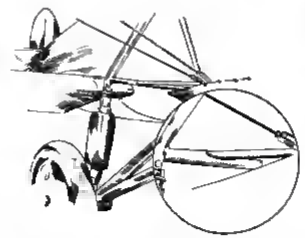
'Sketch of the tail wheel and shock absorber construction of the General Mailplane" — September, 1929



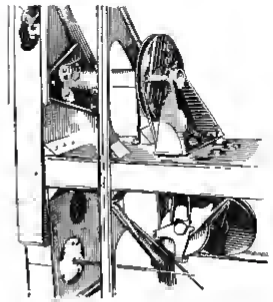
'A sketch showing retracted landing gear of McCarroll Duoplane"—September, 1928.



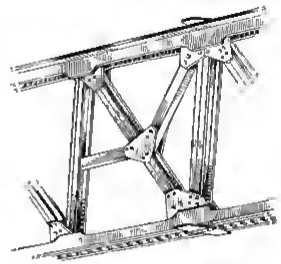
"The unusually long stabilizer travel of the Curtiss Tanager is shown in the sketch of the operating mechanism"—February, 1930.



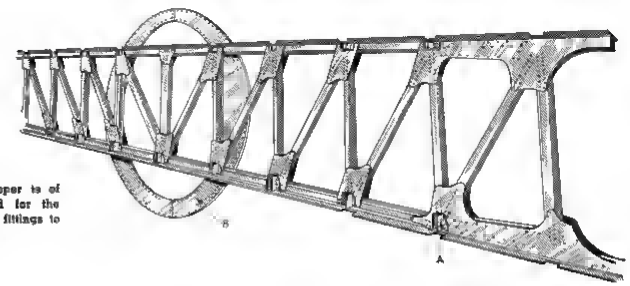
"The sketches showing the new type of landing gear installed on planes of the Waco Aircraft Corp."—September, 1929.



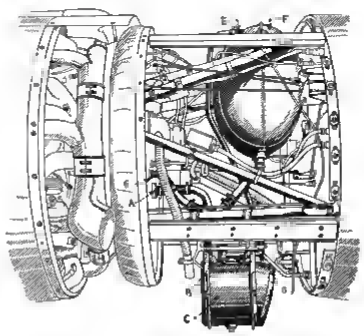
Sketch showing the mechanism used to actuate the trailing edge flaps of the Curtiss Tanager"—February, 1939.



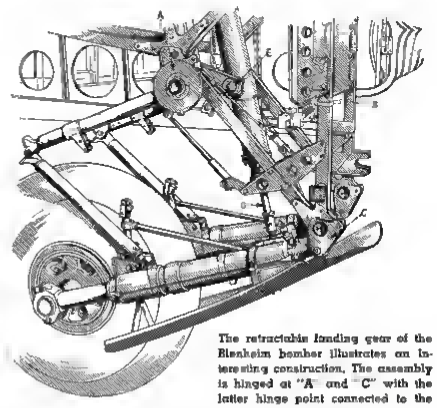
'Construction detail of the spar of the Dornier Do X"—January, 1930



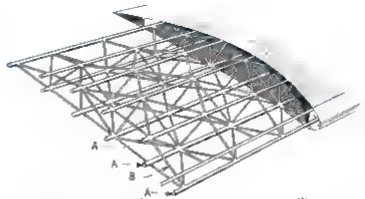
The main wing spar of the fleeing Clipper is of truss type construction. The bulkhead for the engine nacelle is shown at "B" and the fittings to which the nose ribs are riveted at "A".



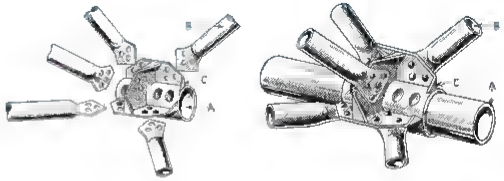
The engine installation of the Northrop N3PB Patrol Bomber has the oil outlet from the engine at "A". From here the oil is led into the oil cooler "C" at "B" and out, after cooling, at "D". The cooled oil enters the oil tank "F" at "E" and is led out the bottom back to the engine at "G".



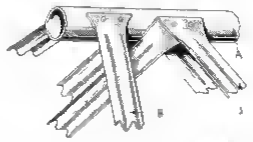
The retractable landing gear of the Blenheim bomber illustrates an interesting construction. The assembly is hinged at "A" and "C" with the latter hinge point connected to the reinforced truss "B". Power for extension and retraction is supplied through the hydraulic piston "D" which is hinged "E".



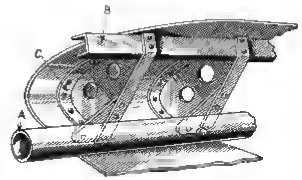
The Junkers Ju. 52 German troop transport utilizes a very complicated type of built up truss wing spar construction. The longitudinal members "A" also shown in the various smaller drawings, are aluminum alloy tubing to which the cross braces "B" are attached by special fittings. (See smaller drawing)



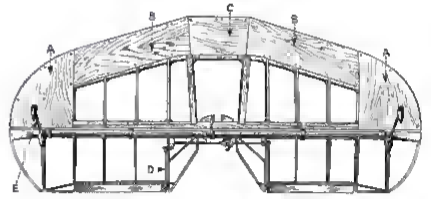
The special fittings referred to are shown here both assembled and disassembled. The longitudinal "A" has the fitting "C" slipped over it and firmly attached. The cross members "B" are then riveted to "C", with their ends being flattened as shown.



In some places the cross braces "B" are attached directly to the longitudinal members. This would seem to prevent riveting difficulties.

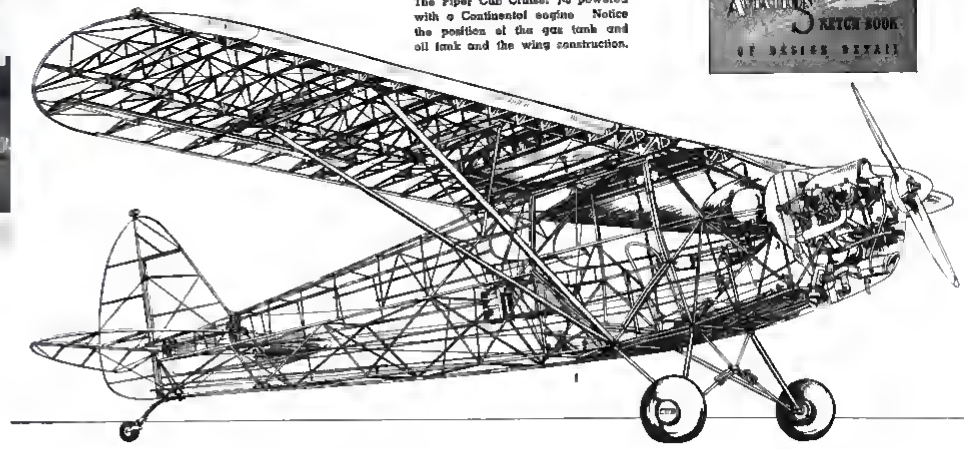


The nose section of the Ju. 52 is reinforced with small nose ribs "C" backing on a channel section "B" and the longitudinal member "A".



At right. The stabilizer and elevator of the Beech D-17 illustrates an interesting construction utilizing wood and plywood. The ends of the stabilizer, "A" are covered with plywood, the surface grain of which runs parallel to the slipstream. The sections "B" and "C", on the other hand, run parallel to the leading edge. "D" is the trim tab control mechanism and "E" is the mass balance for the elevator.

The Piper Cub Cruiser J-5 powered with a Continental engine. Notice the position of the gas tank and oil tank and the wing construction.



The Messerschmitt Me 109 Radio

Here is an interesting description of the radio equipment now being used in one of the most popular Nazi fighters.

By William P. Lear, *President, Lear Avia, Inc.*

The author testing the Messerschmitt Me 109 radio apparatus

ON a murky afternoon last December, a low-flying Messerschmitt 109 was shot down in action over the Thames estuary. Its pilot, mortally wounded by a machine-gun bullet which pierced the left side of the cockpit, managed to bring his ship down intact to a wheels-up landing on the mud flats. Then he died.

This was one of the few Messerschmitt 109's to land on English soil virtually undamaged. Its yellow nose signified that it belonged to one of the better Luftwaffe squadrons. The markings on its tail testified to its bag: one English, two Dutch and two French airplanes shot down.

Salvage crews removed the airplane from the mud flats and turned it over to the British Air Ministry, who removed from it the pilot's papers and most of the instruments. The rest of the airplane—airframe, engine and radio apparatus—was shipped to the United States by Lord Beaverbrook at the request of Mrs. Winston Churchill, who is Honorary Sponsor of Bundles for Britain, for use in their drive for funds in this country. The airplane was crated and shipped in convoy to Canada, and arrived in New York late in June.

Through the courtesy of Mr. Rand Sutherland, of Bundles for Britain, the radio apparatus was removed from the Messerschmitt by our mechanics from Lear Avia's New York office, and the entire radio apparatus was air expressed to Lear Avia's engineering department in Dayton, Ohio, for tests, investigation and critique.

This marked the first instance that an American radio manufacturing concern was afforded an opportunity to examine at first hand German military aircraft radio apparatus. Since a record of the findings should be of some interest to our radio engineers and technicians, the following brief summary and description of this radio apparatus is submitted.

General Observations

The Messerschmitt 109 Fighter type was developed originally in 1933, and its manufacture continues to this day with only slight variations and refine-

Comparing the American and German equipment for equivalent performance, the American "transmitter and receiver complete with a shielded loop for aural-null direction finding weighs less than half of that of the Masserschmitt equipment, and the entire three-way system takes up less space than either the German receiver or transmitter."

William Searle left, and Al O'Donnel, both of Lear Avia, taking the transmitter from the panel in the side of the ship.

ments of the original design Powered with a 1150 hp Daimler-Benz engine, the Messerschmitt 109 has a top speed of 354 m.p.h. at 12,500 feet, cruising speed of 298 m.p.h. at sea level, ceiling of 36 000 feet, and a range of 620 miles Its wing span is 32 ft 6 in, its length is 32 ft. Weighing empty 4,180 lbs, it carries 1,340 lbs. of bombs, and is armed with a 23 mm cannon, two 30 calibre machine guns in the fuselage and two 30 calibre machine guns in wings

The radio apparatus installed in this airplane consisted of a low power fixed-frequency transmitter, a companion receiver, a dynamotor power unit operating from a 24-volt DC power source together with the necessary cables junction boxes and controls

Although the exact date of its manufacture could not be ascertained the radio apparatus, as a type, dates back to around 1933, and although it is definitely known that this type of equipment is still being manufactured, it by no means represents the latest and the best in German military aircraft radio apparatus Parenthetically, it may be added that information on more advanced types of German radio apparatus is on record in this country but exact data and performance figures are not available for public presentation.

The Messerschmitt 109 radio, despite its comparative obsolescence, is significantly symptomatic of German design and manufacturing practices and of the tactical uses of aircraft radio under actual warfare conditions.

From the design standpoint, it is important to note the high degree of standardization of tubes and component parts of German aircraft radio transmitters and receivers Thus the Messerschmitt 109 transmitter design as well as most subsequent and more modern designs, are made around only two basic tubes– Telefunken REM-904 and RES-1664D Similarly, the Messerschmitt 109 receiver and most subsequent and more modern designs have been built around only one basic tube, Telefunken RENS-1264

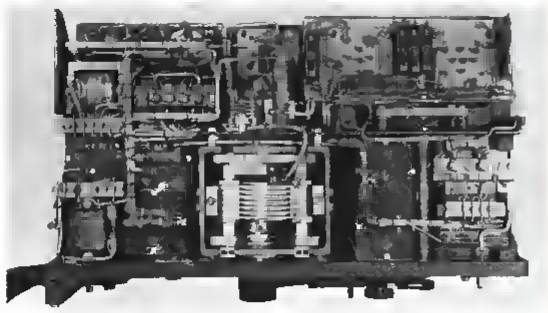
It is evident that the Germans have "frozen" on this design a good many years ago and have concentrated on making a large number of these units available for installation into the Messerschmitt 109's

The equipment is built very ruggedly The chassis of both the transmitter and the receiver are light-weight castings the material used is Elektron, a special aluminum alloy having a high percentage of magnesium which does not burn even when subjected to intense heat The casting and the rest of the equipment is painted a dark gray which is the standard color of the German military apparatus.

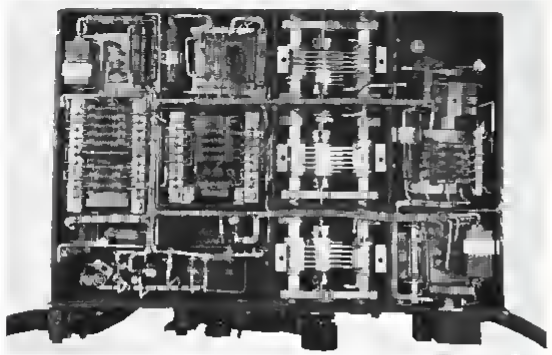
The various units are interconnected with cables complete with their coupling plugs These plugs are waterproof and include a ceramic terminal board for the various connections The practice in this country is to provide cable connections at the receiver or transmitter proper, thus eliminating the disadvantage of having a length of cable with its coupling plug permanently affixed to the apparatus Noteworthy is the fact that while shielded rubber-covered cables are used in this country for maximum dependability under humidity and abrasion, Germans employ the inferior fibre-covered cables, probably indicating a shortage in these essential materials

The workmanship is very good

(Turn to page 224)



Underside view of the German transmitter



What the bottom of the receiver looks like Notice the rugged construction and lost space

The Navy's new Curtiss SNC-1 combat trainer for last, high altitude training. Landing gear folds back into "clam shell" type fairing.

Flying EQUIPMENT

Navy Combat Trainer

New Curtiss SNC-1 for training fighter pilots of the Fleet.

DESIGNED specifically for the training of naval combat pilots during the period directly preceding their transfer to fighting aircraft, the first batch of a large number of newly completed Curtiss advanced trainers was mass delivered recently to the U.S. Navy at Lambert Field, St. Louis, Mo.

The new Curtiss SNC-1 is a two-place, full cantilever, low wing monoplane of all metal construction. Powered with a 9 cylinder 450 hp. Wright Whirlwind, it closely resembles, though smaller, the higher powered Curtiss 21 interceptor which was developed by the same company, the St. Louis Airplane Division of Curtiss-Wright.

Adapted to all types of training activities in naval aviation, including gunnery, bombing and instrument flying, it can be equipped with machine guns and light bombs for training pilots under combat conditions. Equipped with retractable landing gear for increased speed and maneuverability, and split-type flaps for reducing landing speed, it has provisions for radio and transmitter. Oxygen facilities are also provided for combat training at high altitudes.

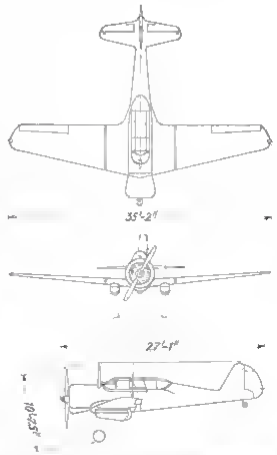
The front cockpit is reserved for the pilot and contains complete flight instruments, engine and armament controls. All flight and power plant controls are duplicated in the rear cockpit equipped for use by an instructor, gunner or observer.

Fuselage is of all metal, semi-monocoque construction, with aluminum alloy stressed skin covering riveted to, and reinforced by, transverse bulkheads and longitudinal stringers. The fuselage is fabricated in two sections, upper and lower, which are riveted together upon assembly. Entire unit is attached to the center panel of the wing by means of two attachment angles. From a point just forward of the tail back to the removable tail cone, the fuselage section is constructed integral with the fin and stabilizer assembly, and the entire unit is bolted to the fuselage.

The full cantilever wing is of all metal aluminum alloy construction with multiple spars having an internal structure of longitudinal stiffeners, shear spars and fore and aft bulkheads which are riveted to the skin. Built in five separate sections, wing structure consists of a center panel, which contains two fuel tanks located near the centerline so that their loadings are concentrated near the center of gravity, the right and left wing outer panels, and right and left wing tips. The covering is Alclad aluminum alloy of the stressed skin type riveted to the stiffeners, spars and bulkheads.

Aluminum alloy covered, split type trailing edge flaps are used, which are supported on aluminum alloy continuous type hinges. Mechanical operation from a crank in each cockpit through a chain drive permits any desired degree of flap position within the specified range. An indicator near the crank in the front cockpit shows the exact position of the flap in all positions ranging from full-up to full down. The flaps extend from the centerline of the plane to the inboard end of each aileron. Ailerons are of aluminum alloy covered structure with metal covering, supported by aluminum alloy continuous type hinges, and are dynamically and statically balanced.

(*Turn to page 232*)



Flying EQUIPMENT

Buffalos at Singapore

Fast, maneuverable, deadly—Brewster fighters stand guard

At Britain's great Singapore naval base, which stands in the way of Japan's greedy "Asia for the Japanese" policy, not the least of the formidable defenses are the Royal Air Force's "hangar after hangar" of Brewster Buffalo fighters.

Named after the water buffalo of the Far East, a dangerous fighter from whose fury even the tiger slinks, but easily manageable by its master when domesticated, the Brewster 339 has been lauded for its high maneuverability in close quarter combat.

Arriving from the U.S. in ocean transports, each ship packed in two cases, the Buffalos are completely assembled and in operation within 24 hours. A midwing monoplane, powered with a supercharged 9 cylinder GR-1820-40 Wright Cyclone of 1200 hp at take-off, the ship has a top speed of about 350 m.p.h., rate of climb from sea level of 4000 ft. per min., service ceiling of 34,000 ft. and a cruising endurance of 10 hr., 40 min. Equipped with four .50 caliber machine guns, two inside the engine cowl firing through the propeller, and one in each wing, the plane also carries two 100 lb. bombs. Fuel tanks are bullet-proof and the pilot is protected by bullet-proof windshield and armor plating. Exceptionally good visibility is provided by the extension of the glass enclosure of the pilot's cockpit well aft, while downward vision is enhanced by a Plexiglas window in the floor of the cockpit.

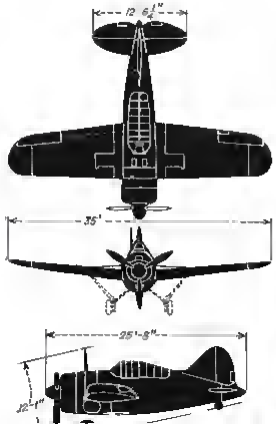
Fuselage is a monocoque structure and the entire exterior surface of the plane is flush riveted, a factor contributing to its speed. Each wing section is a complete unit and bolts directly to the fuselage. The single spar is of box-type design, with great strength. In assembling the Buffalo in the Far East, the wing is placed on holding fixtures and the fuselage is then lowered over it and bolted into place. Fuel tanks are integral with the wing and connection of fuel lines between fuselage and wing and the control cables is a comparatively simple task after the planes arrive. The Buffalo is provided complete with machine guns, armor plating and bullet proof gas tanks, and is ready for combat service immediately upon assembly.

Tail structure is cantilever type and of all metal construction except for fabric covered elevators and rudder. Landing gear retracts sideways into the wing and fuselage, and is equipped with hydraulic brakes.

The midwing arrangement, carefully determined placement and balancing of tail and control surfaces, and the efficient leveraging of the control system all contribute to the extreme maneuverability of the Brewster 339 which is said to have been flown satisfactorily by

(*Turn to page 206*)

A Buffalo flying over a twin-engined Bristol Blenheim bomber at Britain's great Far Eastern naval base.



The single-piece wing is placed on holding fixtures and the fuselage lowered over it and bolted into place. Malay mechanics are shown assembling the Buffalo after its arrival at Singapore.

Hawker Typhoon And The Napier Sabre

By Paul H. Wilkinson

CONSIDERABLE mystery has surrounded the newest fighting and bombing planes developed in England for the Royal Air Force. Perhaps none of these new craft has been such a closely guarded secret as the Hawker Typhoon single-seater fighter. Recently, there have been references to this particular plane in the British press and a sample Napier Sabre engine with which it is equipped has been sent over to the United States. As we in this country release some data at least on our latest fighters, it should prove interesting to see how the new British fighter compares with the best we can produce.

Basically, the Hawker Typhoon is a development of the well-tried Hawker Hurricane, both of these fighters being designed by Sydney Camm. The Typhoon is slightly larger than the Hurricane and is more strongly constructed to take an engine giving approximately 50 percent more power and requiring a corresponding increase in tankage. The similarity in design is noticeable in that both airplanes are low wing monoplanes with bullet-like fuselages and excellent streamlining.

With regard to airframe construction, the Typhoon probably embodies a change from conventional Hawker steel tubing and fabric construction to all-metal stressed skin construction so as to withstand the high operating speeds and high stresses to which the airplane is subjected. The landing gear follows Hawker practice and folds up sideways into the lower surface of the wings while the tail wheel retracts neatly into the lower extension of the fin. The unusual shape of the fin and rudder is due to the necessity for providing ample control surfaces to offset the relatively large side area presented by the high narrow fuselage when the plane is turning.

Various arrangements of armament are possible on a fighter of this type. The successful use of eight 30-caliber machine guns in the Hurricane undoubtedly has been continued in the Typhoon with the guns mounted along the leading edges of the wings. Additional armament in the form of two or four 20 mm. shell guns mounted in the wing stubs gives the Typhoon considerably greater striking power than its predecessor. Armor plate and shatter proof glass are provided for the protection of the pilot and there are self-sealing gasoline tanks. The radiator appears to be located in the nose of the plane directly behind the spinner on the propeller with the propeller shaft from the engine passing through the center of it.

The power plant of the Typhoon is the new 24-cylinder Napier Sabre which is credited with an output of 2,000 hp. Designed by Major Halford who was responsible for the designs of the Napier Dagger and the Napier Rapier, the Sabre hardly can be said to be experimental although its cylinders are arranged in H formation. Liquid-cooling for its relatively small cylinders is an innovation, however, as is the reported use of sleeve valves. Unusually high crankshaft speeds and the use of a two-speed supercharger make the 2,000 hp output possible from this new engine only slightly larger in overall dimensions than its predecessor, the 24-cylinder 1,000 hp. Napier Dagger.

In estimating the weight of the Typhoon, various factors have to be taken into consideration. First, there is the greater weight of the engine, its propeller and its cooling system which would add approximately 850 lb. to the weight of corresponding items in the Hurricane. Second, there is an increase in structural weight due to the slight increase in the size of the airplane and its all-metal construction, and for this an allowance of 650 lb. should be made. Third there is an increase in weight due to the greater armament and armor carried including at least two shell guns and their ammunition, which would add about 350 lbs. Fourth, there is the increase in fuel and lubricating oil load to be taken into account and, for a flight of three hours' duration, approximately 750 lb. should be added.

Summing up, it is seen that these four groups of items added approximately 2,600 lb. to the weight of the Hurricane when it was developed into the Typhoon. Since the weight of the Hurricane with full fighting equipment is 6,100 lb. the weight of the Typhoon therefore is about 8,700 lb. This is equivalent to a power loading of 4.35 lb. per hp. which is appreciably less than the 4.7 lb. per hp. power loading of the Hurricane.

Performance figures of the Typhoon have not been released but they can be estimated fairly closely from the performance of the Hurricane II powered with a 1,300 hp. 100-octane Rolls-Royce Merlin. The increase in engine power output from 1,300 hp. to 2,000 hp. should have resulted in an increase in maximum speed from 350 m.p.h. to approximately 410 m.p.h. for the Typhoon. Likewise, the initial rate of climb should have been increased from 2,500 ft. per minute to 3,500 ft. per minute due to the decrease in power loading. An increase in service ceiling from 35,000 ft. to 40,000 ft. undoubtedly has been attained with the more powerful engine.

The flight range of a fighting plane depends to a great extent upon the mission for which the plane is used. Undoubtedly, the Typhoon primarily is intended for the defense of England. Its major uses therefore are as an interceptor for localized defense against hostile bombers and their escort fighters, or as a front line fighter against hostile bombers and fighters just across the Channel. It does not appear to have sufficient range for use as an escort fighter even with medium range bombers. A flight range of three hours' duration cruising at 325 m.p.h., or two hours' combat most of the time at full throttle, therefore appears to be a fair indication of the capacities of Great Britain's new Hawker Typhoon as a fighting machine.

Photos British Combine

Britain's "Snargasher"

R. A. F. trainer for bombing and night flying operations

QUAINTLY dubbed the "Snargasher" by the British, whose affinity for whimsical names and pronunciations is a well-known attribute, this twin-engined trainer is being flown by advanced R.A.F. students "somewhere in England."

First appearing in 1938, when its prototype was brought out by Reid & Sigrist, Ltd., the 'Snargasher" is a three-place, dual control, midwing monoplane having a twin rudder assembly and fixed landing gear. Designed for training Britain's airmen in bombing, navigation, and night flying, it undoubtedly has played a part in establishing British superiority over the Nazis in night flying operations.

Powered by two DeHavilland Gypsy Six fI aircooled in-line engines, each of 205 hp. and equipped with controllable pitch propellers, maximum speed at sea level is 205 m.p.h. Cruising at 75 percent power at 6000 ft., speed is 190 m.p.h. and range 1000 miles in still air. The "Snargasher" climbs at the rate of 1100 ft. per minute to a service ceiling of 18,000 ft., and the absolute ceiling is 20,000 ft. At cruising speed fuel consumption is 21.80 gallons per hour. The plane's stalling speed is 65 m.p.h.

Fuselage cockpit space provides for crew of three in tandem, the pilot situated over the wing's leading edge, instructor or observer over the wing and the gunner-radio operator who lies in a prone position in an underneath cockpit directly aft of the instructor. A plywood covered structure, the fuselage consists of two large frames and four longerons from end to end with the intermediate spaces occupied by longitudinal stringers with light frames in between.

The wing is a cantilever structure built in three sections. In the center section two spars extend through the fuselage and are attached to the fuselage frames. Outer panel spars are open box type with laminated flanges and spacers. The fabric covered, metal framed hinged trailing edge is slightly forward and below the trailing edge of the wing, with the outer sections functioning as ailerons and the inner sections as flaps, a peculiarity which may have had some influence in the naming of the craft. Fins and rudders are of fabric covered wood construction.

Specifications and performance data for the "Snargasher" advanced trainer powered by two DeHavilland Gypsy Six II engines of 205 hp. each are as follows:

Span	36 ft 4 in
Length	28 ft 4 in
Height	8 ft 11 in
Gross weight	4,900 lb.
Weight empty	3,000 lb.
Wing area	212 sq. ft.
Wing loading	23.1 lb./sq. ft.
Power loading (take-off)	11.95 lb./hp.
Maximum speed (S.L.)	205 m.p.h.
Cruising (75% power at 6000 ft.)	190 m.p.h.
Stalling speed	65 m.p.h.
Climb	1,100 ft./min.
Service ceiling	18,000 ft.
Absolute ceiling	20,000 ft.
Flying duration	5.25 hours
Range (still air)	1,000 miles

Britain's twin-engined "Snargasher" trains R. A. F. students in navigation and night flying for the growing bombing offensive over Germany

Air Lines Seek Stability

By Selig Altschul

ONE of the main purposes of the Civil Aeronautics Act of 1938 was to introduce stability and facilitate the healthy growth of commercial air transportation. The Act instructs the CAB to fix the amount of air mail payments to enable the individual carriers, under honest, economical, and efficient management, to maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service and the national defense.

This broad policy has, for the most part, been followed in the air mail rate decisions of the CAA and CAB. Now comes an examiner's report on the mail rate proceedings of American Airlines—which if upheld by the Board—will negate the intent of the Act and have a tendency to undo much of the stability that has been introduced in the industry.

The examiner—Frank A. Law, Jr.—proposed that the Board determine whether American should be required to return alleged overpayment of mail compensation. While Mr. Law did not specifically state that this restitution should be made, the inference is quite clear. The examiner claims that American should have been paid only 20.86 cents per plane mile for the approximately 13 million miles flown during 1940 when the company actually received pay at the average rate of 30.11 cents a mile. This indicates an overpayment of more than $1,240,000 which American would be forced to return if so ordered by the Board.

This is the first time the Board has been called upon to determine whether a company has been overpaid—and if so, whether retroactive adjustments should be made. While American is directly involved, the precedent-setting attributes of this case will vitally affect the entire air transport industry. Should the CAB concur with Examiner Law, the stage will be set for the government to re-examine mail compensation for all air lines going back over a period of years with the object of recovering overpayments. *In this event, it may become virtually impossible for any air carrier to do any future financing.* Any investor would be foolhardy indeed to make a commitment in any company which may be constantly liable for the return of a substantial portion of reported earnings of previous years.

It is because of these future implications that the retroactive aspects and their basis, as indicated in Examiner Law's report, are deserving of study and comment.

One of the most unfortunate features of the report is the failure to recognize conditions as they exist today and as they were when the rate proceedings were first started. In March, 1939, American, on its own petition, sought to increase its mail compensation on Routes 4 and 23—representing its transcontinental route. Subsequently, in December, 1939, on its own motion, the CAB instituted an investigation of mail rates on all of American's routes. Hearings were not held until a year later—proceedings being conducted from Dec. 5 to Dec. 15, 1940 with briefs filed on Feb. 19, 1941. It must be noted that the record was bound to contain the results of American's most successful period. The kaleidoscopic events of world affairs did not quite foretell the restrictive influences that were soon to be imposed upon air line operations. Nor was it possible to accurately predict the adverse results of the 1941 first quarter. Increased operating costs of a multiple nature—but largely due to the exigencies of the defense program—were just beginning to become evident in published reports.

Further delay will now ensue before the CAB will rule on the examiner's report. These protracted proceedings make it difficult to implement a decision—regardless how just—which requires the return of a material portion of a company's previously reported earnings. It was on its 1940 earnings, for example, that American made certain representations which permitted the successful sale in November, 1940 of an issue of 50,000 shares of $4.25 preferred stock at a premium. (Examiner Law repeatedly refers to this issue as a $4.50 preferred. This quarter of one-percent difference is noteworthy as it speaks well of the company's ability to obtain a lower coupon rate. Furthermore, this difference represents an annual saving of $12,500 which can purchase one complete engine and a propeller.)

Perhaps the most fallacious assertions in Mr. Law's report are the statements that the air transport industry has "passed beyond the stage of business hazard or uncertainty," and that "such a business is no longer speculative." The events of the past six months tell their own story.

It is true air transportation is an established permanent industry and has strong growth characteristics. However, its earnings record and financial background require considerable "sensoning" before it may be said that the industry is out of the speculative hazard class.

For example, it was only in 1939 that the industry as a whole showed its first year of profitable operations. During 1940, net earnings were only about $4,400,000 albeit an improvement over the $3,250,000 recorded the previous year. The air lines cannot finance their expansion through their own resources. According to our own survey, about $13,000,000 was raised during 1940 through new equity financing. Thus far in 1941, approximately $1,400,000 has so been provided. Interestingly enough, current market prices for each of these new issues are, for the most part, materially below the original offering prices. These amounts exclude substantial capital secured through bank loans and equipment notes. Were the air lines free to maintain their normal growth, the need for capital would surpass previous requirements. In any event, an indication is at hand as to the future capital needs of the industry.

The air carriers, as a whole, hardly present a picture of financial strength. As of April 30, 1941, the 15 domestic air lines had aggregate cash resources of less than $15,000,000 and net working capital of about $17,665,000. Moreover, three of the major lines accounted for 88 percent and 91 percent respectively of such resources. Any number of individual industrial and railroad companies can boast of working capital balances far in excess of that for the entire air transport industry. For example, Pullman, Inc. last reported cash of $48,000,000 and net working capital of almost $81,000,000.

The contention is also advanced by Mr. Law that American used excessive depreciation charges. The examiner rightfully remarks that "depreciation in this industry is largely the result of obsolescence rather than wear." However, the point is made that lack of new equipment, due to the defense emergency, postpones the obsolescence of the existing aircraft and hence depreciation charges should be reduced. In applying lower accruals, however, pre-

(*Turn to page 166*)

Reliable Fabrics for AMERICAN WINGS

53 C—Long Staple—Light Weight Airplane Cloth is the fabric generally selected by the manufacturers of light weight planes for civilian flying. Like our B*A 30, these lighter weight fabrics have a remarkable resistance for uniformity in weight strength thread count and surface characteristics

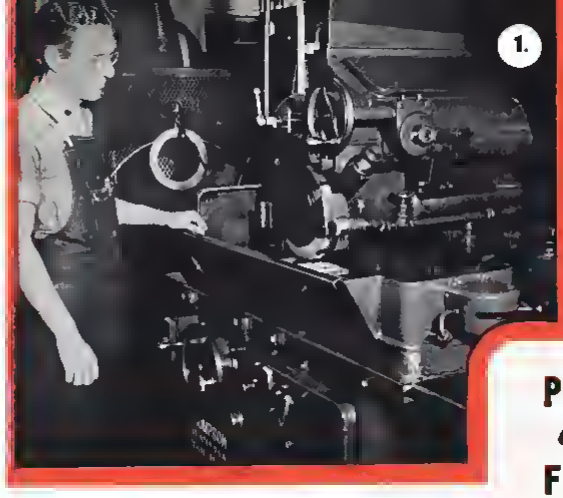
Years ago, when America's wings were the great white sails of the clipper ships, the reliable sail duck manufactured and distributed by Wellington Sears Company was specified by many a skipper.

Today's builders of both military and civilian aircraft also look to our reliable fabrics for wing coverings that will stand the strain of modern high speed flying. B*A*30—Grade A Airplane Cloth is widely used in both army and navy planes because of its remarkable uniformity, in strength, in weight, in thread count and in surface characteristics.

It is natural that an organization such as ours equipped with the finest of practical commercial textile laboratory facilities and producing over 25,000 cotton fabrics in 19 modern mills, should attain the same leadership in the development of these fine fabrics as we enjoy in the case of our Martex towels, Wellington Sportswear Fabrics and fabrics for industrial use.

WELLINGTON SEARS COMPANY

65 WORTH STREET, NEW YORK, N. Y.



PRECISION GRINDING
on a production basis
FOR WINGED DEFENSE

THOMPSON GRINDERS

Here is tangible evidence of the important part Thompson Grinders are playing to speeding up production of defense aircraft.

The major portion of Thompson output is now scheduled for this important branch of defense. A large majority of the prominent names in the aircraft industry are benefiting from the reliability, accuracy and productive speed of hydraulically controlled Thompson Grinders.

Thompson builds a complete line of precision grinding machines in single and two wheel types in sizes to meet the individual needs of aircraft production—to speed completion of thousands of planes so that we may be safe.

We are anxious that all of the aircraft and allied industries become acquainted with the many advantages and economic flexibility provided in Thompson Hydraulic Surface Grinders. Full descriptive bulletin upon request. Write.

1 Typical Thompson Grinder operation at North American Aviation plant, Inglewood California

2. Grinding landing gear parts on Thompson Grinders at Curtiss-Wright, Buffalo N. Y.

3. Grinding punch press die in tool room of Vultee Aircraft, Vultee Field, Calif.

4. Surface grinding landing gear part at Boeing Aircraft, Seattle, Wash.

5. Grinding between cheeks of connecting rod with power operated rotary fixture at Wright Aeronautical Plant, Paterson, N.J.

THE THOMPSON GRINDER COMPANY

SPRINGFIELD, OHIO, U.S.A.

Aviation RADIO

Dialing the Air Waves with Craig Walsh

Radio Maintenance at American Airlines

The importance of radio for communication and navigation in commercial airlines in the United States can be judged by the manner in which American Airlines keeps its radio equipment in first class operating condition. At LaGuardia Field in New York City where American Airlines has its main overhaul shops, there is a first class radio repair shop manned by a competent staff of radio mechanics. This staff is capable of, and has facilities for, the location and correction of the many faults liable to develop in even the best of aircraft radio equipment. The shops are completely air conditioned to maintain optimum working conditions regardless of the weather outdoors. Also, they are lighted with the most modern mercury vapor lamps.

As a matter of routine all radio apparatus is removed from service after each flight for checking and every three months for a complete overhauling. In addition, whenever any apparatus is suspected by a pilot or anyone else using it that it is not operating exactly as it should, it is immediately pulled out for checking. The suspected equipment is brought to the line maintenance shop which contains complete checking equipment for thorough testing of all the different types of apparatus now in use on the airplanes of this company.

New models can also be checked on this universal tester as they are introduced into service. The work here is limited to checking instruments for proper operation. If they are in need of repair they are sent over to the repair shop, where the trouble is located and corrected.

The universal testing panel should be of considerable interest because, together with a signal generator, it is capable of testing a wide variety of receivers under normal operating conditions. It contains an antenna and transmission line system which simulates that of an actual installation in an airplane. A number of meters are provided to measure voltages and currents at various points in the receiver under test. For convenience of handling and to prevent errors, each type of receiver has its own connecting cable with special plugs to connect it to the test panel.

Marker beacon receivers operating at a frequency of 75 megacycles are tested with a crystal controlled 75-megacycle signal generator whose carrier signal is modulated at 400, 1300 and 3000 cycles per second. The modulation frequencies correspond to the modulating frequencies used in the marker beacon transmitters to light the different colored lights on the receiver as the plane passes through the marker areas. Power supply units such as generators and dynamotors are also tested in the same shop.

The repair shop itself contains several shielded rooms with adequate test equipment for analyzing the troubles which afflict radio equipment. The bench space is sufficient for the repair personnel to work without crowding. The shop also contains mechanical equipment for considerable sheet metal work and to make replacement parts as the necessity arises. Under construction at this time is a transmitting tube tester which will test the tubes in circuits which simulate actual operating conditions. This will provide an additional safeguard on the operation of the communications system and at the same time will permit the use of the tubes up to the end of their useful lives.

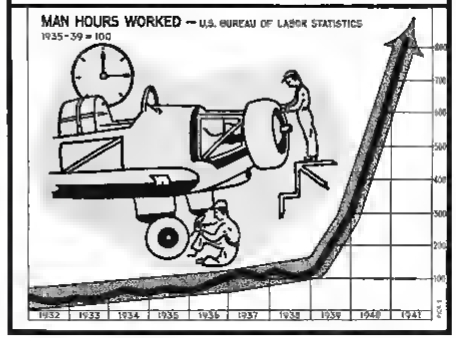
Radio compasses are tested in a special shielded room where a single signal can be directed in a known direction across the room. This signal is provided by a signal generator to which is connected an antenna consisting of a single wire strung across the room. It is highly desirable that the unit under test be placed on a platform which is adjustable in height and which can be easily and quickly rotated. Nothing could be more suitable than a barber's chair. When a chair was being purchased from a second hand barbers' supply dealer who couldn't understand the problem at hand the dealer said

(*Turn to page 206*)

An aircraft radio transmitter undergoing test in the line maintenance shop. An antenna and transmission line are included in the test set to simulate the actual operating conditions.

General view of the American Airlines radio repair shop where all radio equipment of the company undergoes a thorough overhauling at periodic intervals.

AIRCRAFT PRODUCTION INDEX

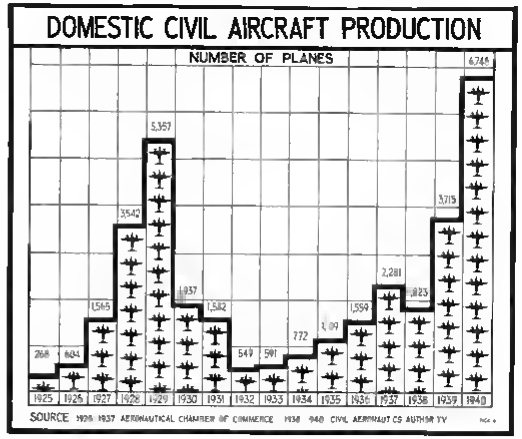


The index of man hours in aircraft production rose slowly until the end of 1938. It has been climbing steeply since that time, and will probably continue to increase at the same rate through the balance of this year.

More Money More Hours More Planes

How the aircraft industry has grown through the years

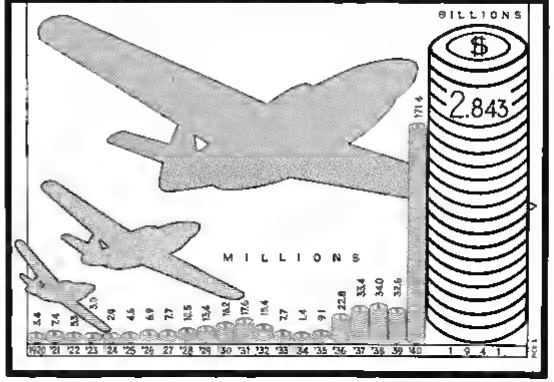
DOMESTIC CIVIL AIRCRAFT PRODUCTION



Right: This chart shows U. S. civil plane production and does not include military airplanes. Note the decrease during the depression years and the rapid climb in 1939 and 1940.

FROM MILLIONS TO BILLIONS

U.S. EXPENDITURES FOR PROJECT AIRPLANES



Left: The Army and Navy have been starved financially for years with the low point for airplanes being reached in 1934. Even in 1939 appropriations were less than in 1938. The drastic increase in 1940 and 1941 are clearly shown in this chart.

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

For testing aircraft electrical systems the entirely new and modernized version of the Willard Electrical Check, type WD-2, which has been placed on the market by *Willard Storage Battery Co.*, Cleveland, Ohio, should be generally applicable. New portable model is light in weight and the test circuit is completed quickly in one simple hookup. One feature eliminates need for removal of battery terminal connections when determining current output required for starter and accessories. Another development is special contact shunt test lamp to obtain the current regulator setting or generator charging current. The WD-2 is also equipped with current load resistor for checking vibrating current regulators. This imposes a load on battery sufficiently high to permit testing and setting of current regulators without installation of a discharged test battery or shorting out of the voltage regulator.—AVIATION, *August, 1941*.

Willard Electrical Check

Cutting and grinding compound may be easily prepared from Gunk P-96 Concentrate simply by adding 3 volumes of light lubricating oil and a low-cost petroleum distillate. This discovery has just been announced by *The Curran Corp.*, Malden, Mass., makers of Gunk. In addition to finer grinding results that may be obtained on certain metals and jobs, the concentrated Gunk is said to impart to the emulsion, by virtue of its alkyl phenol content, a definite sanitizing and sterilizing action on all surfaces. It is also said to leave ferrous metal surfaces resistant to rust formation.—AVIATION, *August, 1941*.

Curran Gunk Concentrate

A tricky problem of aircraft production has been solved by a new portable tool weighing only 2 lb. On all modern aircraft, thousands of nut plates are used for securing cowlings, fairing strips, etc. Formerly, three rivet holes had to be marked off and drilled separately for every one of these plates. Today, in one swift operation, the novel two spindle portable drill, designed by *Desoutter Bros., Ltd.*, of London, England, drills two holes, accurately spaced and centered.—AVIATION, *August, 1941*.

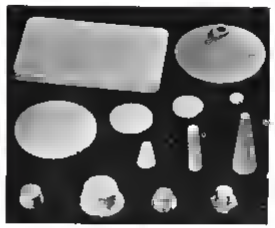
Tackle Twill, a rayon and cotton fabric, has been selected for the first 500 parachute troop uniforms and is also being used in the uniforms of Navy pilots. Made by *William Skinner & Sons*, New York, N. Y., Tackle Twill is composed of American Viscose Corp.'s special high tenacity, lustrous rayon yarn plus the finest long staple cotton. This construction is said to give amazing resistance to abrasion. Colors are all fast vat dyes and cloth is subjected to three cold water shrinkings. For aviation use garments have been made with rayon twill side in and also in the reverse construction, depending on whether smoothness was more necessary on the inside or on the outside.—AVIATION, *August, 1941*.

Newly designed pneumatic counterbalance cylinders for large, straight-side punch press equipment is brought out by *Dayton Rogers Mfg. Co.*, Minneapolis, Minn. These Model GT cylinders operate direct from the air line system in the shop and serve to counterbalance the large rams on larger straight-side presses, compensating for increase or decrease in size of die tooling equipment fastened to the press ram. Counterbalance cylinders are installed in groups of 2, 4 or 6 and automatically take up the lost motion due to wear of parts and the large clutch mechanisms. By use of these cylinders a press operating with a clutch jam may be operated without use of the retarding brake or with only slight friction on brake itself.—AVIATION, *August, 1941*.

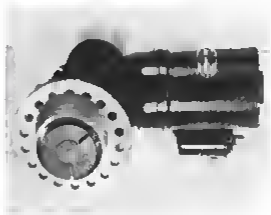
Dayton Rogers Counterbalance Cyl.

A master test stand for quick and accurate testing of aircraft hydraulic and accessory equipment has been developed by *Air Associates, Inc.*, Bendix, N. J., as one unit of a complete line of testing and servicing equipment. Model 840 Master Test Stand permits testing, adjusting and calibration of practically all engine-driven accessories in accordance with Army and Navy specifications. Heart of unit is a 15 hp. a.c. motor incorporating a magnetic clutch that allows output speed variation from 100 to 4,500 r.p.m. Special attention has been given to efficient mounting of instruments and meters on rear panel. Several selector valves provide wide diversity and flexibility of operation, resulting in a piece of equipment not only answering present-day needs, but capable of testing accessories of the future.—AVIATION, *August, 1941*.

Air Assoc. Master Test Stand

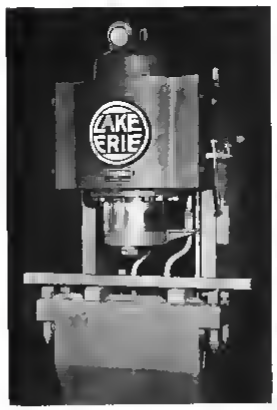


Moraine "Porex



Champion Elec Engine Starter

Stanley Electric Portable Polisher



Lake Erie Straightening Press

A porous metal product called "Porex" has just been introduced by *Moraine Products Division* of General Motors Corp., Dayton, Ohio. Porex has two principal functions, to remove foreign materials from fluid, such as oil, and to alter the characteristics of gases by diffusion, reducing pressures and controlling flow rates. One important feature of Porex is its ability to be bonded to steel and copper. In this way it can be made an integral part of solid metal which may be machined, ground, bored, threaded or processed for specific requirements. Applications may be found in almost any equipment involving flow of gases or liquids, such as pumps, fuel lines and lubricating systems.—AVIATION, *August, 1941*.

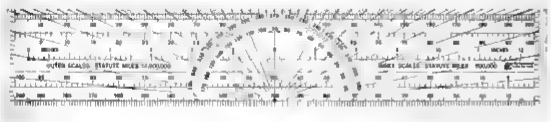
A new line of electric direct-cranking airplane engine starters has been introduced by *Champion Aviation Products*, Los Angeles, Calif. Features of the new Champion starters, designed for engines up to 200 and 300 hp, are sturdy construction, light weight, and low initial cost. Champion is already well known for its line of wind driven aircraft generators. A new model electric starter for lightplanes is now under development. The present models are complete with solenoid, enclosed type starter button, and both models fit standard 4 in. or 5 in. mountings. Model 200R, less solenoid, weighs 16 lb., 12 oz., while the larger model, less solenoid, weighs 18 lb., 14 oz.—AVIATION, *August, 1941*.

High lustre finish on stainless steel, brass and other metals can be obtained with the Stanley portable electric polisher, No. 182, which may also be used as a drill. Made by *Stanley Electric Tool Div.*, The Stanley Works, New Britain, Conn., this double purpose tool's slow speed of 600 rpm. is ideal for polishing and cleaning jobs, and used with drill chuck it has ample power and chuck capacity for ½ in. drilling in wood or metal. Universal motor operates a.c. or d.c.—AVIATION, *August, 1941*.

Heavy duty hydraulic straightening presses are being brought out in a new line by *Lake Erie Engineering Corp.*, Buffalo, N. Y. Special features are C-frame for convenient handling of long bars, and fast operation with sensitive control of pressure and stroke. Bed is fitted with V-blocks adjustable to suit work. Spring rollers at ends facilitate movement of bars. Control is by means of conveniently located hand lever, operation of which determines desired pressure. Pumping unit is located at bottom and back of press. Complete data and specifications available upon request.—AVIATION, *August, 1941*.

Especially valuable for feeding polished brass, aluminum, plastics, thin tubing, etc., the Lipe Pneumatic Bar Feed is a self-contained automatic power stock feed device used with machine tools having fixed stops. Made by *W. C. Lipe, Inc.*, Syracuse, N. Y., it eliminates all troublesome feed parts of screw machines, turret lathes, and cut off machines. Consisting of an air cylinder long enough to contain full length stock bar, it is available in three models, 125, 225, and 300, having capacities of one, two and 2½ in. diameters, 12 ft. long, respectively. The Lipe Bar Feed will feed any distance, holding stock firmly against stop until collet is closed, and will not mar or scratch any material.—AVIATION, *August, 1941*.

Lipe Pneumatic Bar Feed



C-Thru Distance Scale

For use in actual flight problems, the Distance Scale with Air Navigation Protractor, made by *C Thru Ruler Co*, Hartford, Conn, serves innumerable uses in making all sorts of calculations Scale is a clear transparent material, $2\frac{3}{4} \times 12\frac{1}{2}$ in which permits large legible figures and distinct lines These lines and figures cannot be erased or rubbed off as they are embedded between two laminated layers of the material Scale may be used for plotting courses on a Mercator chart, or other aeronautical map, and for measuring distances on U S Coast Geodetic Survey map, using outer scales 1:1 000,000 for regional maps, and inner scales of 1 500,000 for section maps —AVIATION, *August 1941*

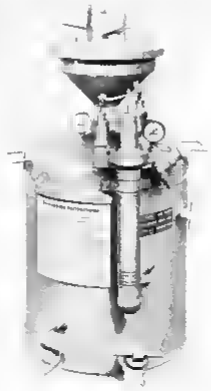
An acetylene generator, designed for maximum portability, for use in oxy-acetylene welding and cutting, is just announced by *Linde Air Products Co*, unit of Union Carbide & Carbide Corp New York, N Y Known as Oxweld MP-10, it will deliver 30 cu ft of acetylene per hr and is suitable for welding metal up to $\frac{1}{8}$ in thick and for cutting steel up to 5 in thick Simple and easy to operate generator can be recharged speedily Pressure of acetylene is controlled by a regulator forming integral part of generator, and the separate pressure gage indicatees at all times pressure within generating chamber Strongly constructed of welded steel parts, it weighs only 100 lb empty, 250 lb charged —AVIATION, *August, 1941*

Builders' plastic which is an excellent protective against corrosion, should find wide acceptance in hangar construction and airport buildings throughout the country Quaintly called Wet-X-Hale, and made by *Rogear Co*, 11 Water St, New York, N Y., it creates a thorough bond on any smooth or rough surface and is available in several whites, pastels and other shades Applied with brush or spray gun, no wire mesh or lath is needed Non-peeling and non-cracking, this builders' plastic is an oil base Portland cement product combined with indestructible fine aggregates which is water- and shockproof and has insulating and sound deadening qualities —AVIATION, *August, 1941*

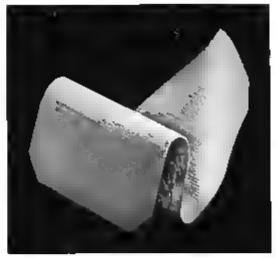
A recent battery development for lightplanes and special power supplies on heavier aircraft, so designed as to eliminate previous CAB requirements of a metal container and drain, and acid-resistant paint on adjacent structure, is offered by *Reading Batteries, Inc*, Reading, Pa Approval has been granted by CAB for installation of two non-spill 6-v types, and both batteries, one a 24 A.H, the other a 33 A.H, are identical in size, thereby requiring only one provision for installation Each of the three cells is fitted with a hard rubber cell cover securely attached to cell terminals by means of threaded non-corrosive locknut and soft rubber bushing to insure a tight seal —AVIATION, *August, 1941*

Fybr-Tech, said to be an ideal substitute for aluminum sheet in aircraft, and to be actually stronger and only about one-quarter the weight of aluminum, is being supplied by *Technical Plywoods*, 228 N La Salle St, Chicago, Ill Fybr-Tech consists of wood veneer or plywood core, with sheets of vulcanized fibre resin-glued to both faces by the hotplate process It has high tensile strength and resistance to abrasion as well as good bending and forming properties, uniform thickness and minimum warpage Any size up to 48x96 in.—AVIATION, *August, 1941*

Combining the deep throat of the standard clamp with the tremendous holding pressure of a toggle movement, "Klampacto," announced by *Knu-vise, Inc*, Detroit, Mich., is an improved model of the firm's Toggle Action "C" clamp Equipped with two handles, it is unnecessary to hang onto the clamp and work when fixing it into position, for just a squeeze of the hand applies it with 2000 lb pressure To avoid spatter when arc welding, it is furnished with patented Kam-Lock adjusting rod The "Klampacto" CEE Clamp comes in 3 models with a 5 in, 6 in, and 10 in jaw each.—AVIATION, *August, 1941*



Linde Acetylene Generator

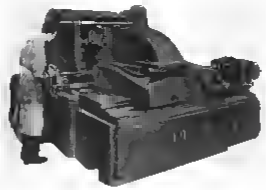


Rogear Wet-X-Hale Plastic

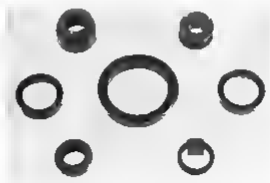
Technical Plywoods Fybr-Tech

Knu Vise "Klampacto"

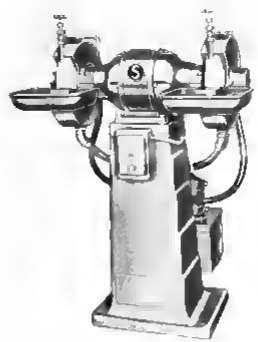
Hammond Chip Breaker Grinder



Nutt Broach Gear Shaving Machine



Goodrich Ameripol Gaskets



Standard Wet Grinder

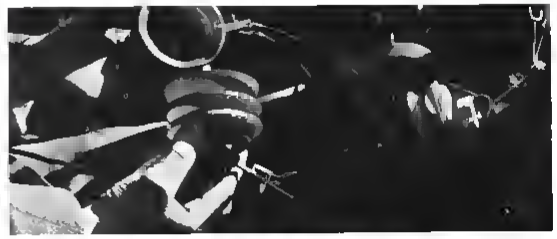
Having a 4 in peripheral Diamond wheel, a new chip breaker grinding machine for carbide tools has been placed on the market by *Hammond Machinery Builders, Inc*, Kalamazoo, Mich. Built around a new-type universal-angle tool vise, the machine provides three separate planes of adjustment in setting grinding angles. Each plane adjusts by means of accurately scaled readings. For wet grinding, a coolant tank is mounted over the 4 in. wheel with flow controlled by a needle valve. Grinding assembly on left side of machine may be used for rough or finish grinding. A tilting work table, slotted for protractor angle-guide and fitted with easily cleaned sludge pan underneath, is mounted on a 1¼ in. machined shaft. Powered by a ball bearing, ½ hp. motor, heavy duty reversant type permitting right or left hand grinding, Hammond grinder is furnished either as bench or floor model.—AVIATION, *August, 1941*

Entirely automatic, the new horizontal Red Ring Gear Shaving Machine is just announced by *National Broach & Machine Co*, Detroit, Mich. Used for gears up to 36 in. dia., 2 in. pitch and having face widths up to 36 in., an important feature of this machine is ability to develop the elliptoid tooth form so effective in eliminating gear failures and rapid gear wear due to end bearing of gear teeth in operation. Action of machine is under control of microflex timing units which are in turn controlled by elements on electrical panel board in base of machine. Cutter head slide is adjustable for center distances up to 50 in. and the head itself accommodates cutting tools of 7, 9 and 12 in. in diameter.—AVIATION, *August, 1941*

The new synthetic rubber, Ameripol, is proving the most satisfactory material yet developed for various forms of gaskets and rings to keep oil or grease confined to bearings, it is reported by *B. F. Goodrich Co.* Akron, Ohio Company has found Ameripol is best seal material ever used to resist petroleum derivatives and that it doesn't swell in gasoline at room temperatures. Even after immersion in oil for long periods, Ameripol does not swell materially and retains a high degree of flexibility and abrasion resistance.—AVIATION, *August, 1941*

One of the recent developments of *The Standard Electrical Tool Co.*, 1919 W. 8th St., Cincinnati, Ohio, is a line of 12 and 14 in. heavy duty wet grinders. Arrangement consists of wet grinding hood with integral splash bowl and adjustable work rest. Equipment on each guard includes a valve for controlling flow of water, adjustable nozzle and suitable piping. Bottom of guard trough is fitted with hose connection for gravity return of water to tank. A motor driven pump with tank is secured to back of pedestal and has capacity of 10 gal. per min. Both grinder motor and pump motor are operated simultaneously through push button safety starter at front of machine. Machine is also available as combination wet and dry grinder.—AVIATION, *August 1941*.

Headphone cups that take all the pressure of hard rubber away from your ears and distribute it over the side of your head, have been designed by Ray W. Brown, Manager, Aviation Dept. at *The General Tire & Rubber Co.*, Akron, Ohio. New cups are worn in two ways—in an accordian fold which cushions against the head, or in a fold-back position which gives a soft but firmer contact. Made of treated latex which will not chafe the ears or head even after hours of wearing, the new cups provide relief from an annoyance heretofore endured by all pilots.—AVIATION, *August, 1941*.



General Tire & Rubber Headphone Cups

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BETHPAGE, LONG ISLAND, NEW YORK

THE AVIATION NEWS

BLAINE STUBBLEFIELD, Washington — C. F. McReynolds, Pacific Coast — Jay P. AuWarter, New York — E. R. Lockin, New York

AUGUST 1941

Bombers Nearly Twice Size of "Fortress" Planned for 500-a-month production program

Washington (AVIATION Bureau)—Long range heavy bombers nearly twice the size of the "flying fortress" type are to be included in the new program to bring heavy bomber production up to 500 a month. In addition to the Boeing B-17 and Consolidated B-24, two other ships are in the program—Boeing's B-29 and Consolidated's B-32. Little is known about these planes, which are still in the design stage, but they are believed to be in the 40-ton class as compared with 25-28 tons for present four-engine equipment) and presumably will be powered with the 2,300-2,500 hp engines expected to be available next year.

Although production of these two ships is doubtless some time away, priorities have already been granted for the necessary materials, tools, and accessories.

A third ship of this class which is believed to be under consideration though it has not yet been definitely included in the program is the Lockheed B-43, a military version of the Constellation transport of which three are now being built for TWA.

For the present the forty-ton range seems to represent the largest size to be produced in quantity. Douglas' 70-ton B-19 is now being flight tested, but it is a long way from quantity production. Studies of the B-19 aim to learn about the aerodynamics of big ships and to explore its possible uses as a troop or tank carrier or as a sort of patrol ship analogous to the big Navy boats.

The biggest Navy boat—Martin's 85-ton job—is still subject to rigid secrecy. It will

(Turn to page 136)

News of the Day Newsreel

We hope this Russian photograph scares the Nazis, but it isn't likely. Russian planes are a great enigma.

World's most powerful bomber in the air. Mighty Douglas B-19 has been going through a series of flight tests at Santa Monica. With four 2,000 hp Wright engines, this battle wagon of the air can fly non-stop 7,750 miles. Over 700,000 man-hours were involved in building the B-19.

ARMY EXPERIMENTS WITH LIGHT PLANES. Officers from Armored Force division pause to complete details of mission to be performed under radio direction from Piper Cub Trainers. Seven Cubs were successfully used in liaison work: artillery spotting, and courier service recently during the second army maneuvers in Tennessee.

Summer, Fall, Spring, CPT Classes Announced, At 800 Training Centers: 16,000 Applicants

Washington (AVIATION Bureau)—Under a congressional appropriation of $25,000,000, plans for continuation of the CAA Civilian Pilot Training Program have been announced by CA Administrator Brig Gen Donald Connolly.

As in the year just closing, the program will be divided into three phases: summer, fall and spring. The summer classes will get under way immediately at more than 800 training centers with 16,000 applicants, as follows:

In the Private Course 10,020 college men, at 579 Training Centers; in the Private Course 1,000 non-college men at 135 Training Centers; in the Secondary Course 3,010 at 221 Training Centers; in the Cross Country Course and in the Instructors Course, 2,000 at 164 Training Centers.

In addition to carrying on the established private and secondary courses a new course is being offered the Cross Country course of 40 to 50 hours flight training and 108 hours of ground instruction, which leads to the Instructors Course. Applicants successfully completing these four courses will have accumulated 160 flight hours and 360 ground hours, enough to take the test which qualifies them for a commercial certificate and an instructor rating.

The great problem facing the expanded program was the shortage of instructors. A certain measure of this had been met by the re-rating of pilots already holding instructor ratings. 'Refresher' courses plants then qualified for instructor ratings.

Under the new arrangement a large percentage of the pilots already trained by the CAA will be able to take additional courses, permitting them to accumulate sufficient hours to get their commercial grades and instructor ratings, thereby completing the cycle.

Expect "Coordinator" in Charge Air Space

Confusion between civil and military flying, and the increasing use of the air by the Ferry Command which delivers planes to ports for flight and shipment to Britain, has created a demand for an air coordinator. Undoubtedly this coordinator job will go to the Civil Aeronautics Authority, which will umpire, probably from the control towers, the operations of air transport, the Air Forces, and private flyers.

Congress is being asked as this is written to create authority for CAA, and to give it funds to perform the duties of coordinator. Under this program, control tower men would be trained, and further standardization of airport lighting and operations would be expected.

CAB Sets 3 Flight Levels

The federal government took a step further into control of the air space when the Civil Aeronautics Board amended its rules requiring that after July 1 all aircraft operating on the civil airways between altitude 3500 feet above the ground and 17,000 feet above sea level, must at all times be equipped with radio receiver, radio transmitter, and a sensitive type altimeter.

When entering an area under the jurisdiction of a U S Airway Traffic Control Center, the pilot must file a flight plan. In addition, all aircraft flying between 3500 and 17,000 feet must maintain specified altitudes, depending on the direction of flight.

The Board also designated the air space above 17,000 feet for military operation, except for specially authorized flights.

The airspace below 3500 feet remains free for the use of all pilots with no more restrictions than heretofore, permitting pilots without special equipment to fly crosscountry as always. Other amendments require that pilots flying contact shall stay 500 feet above or below an overcast. The previous rule was 300 feet.

75 New Airports Approved This Year

Washington (AVIATION Bureau)—Seventy-five new airports have been approved for the system of defense since January 1, as compared with only 51 added during 1940, Brig. Gen. Donald H. Connolly, Civil Aeronautics Administrator, announces. In addition, more than 100 others have been improved under the $40,000,000 program of last December.

Many others will be added and approved before the year ends, aided by a Congressional appropriation to the CAA for building and improvement totalling more than $94,000,000 which became effective July 1.

Locations of 191 airport sites to be surveyed for possible airport construction or improvement work under the Civil Aeronautics Administration for the year beginning July 1, were announced recently. These locations are necessarily tentative as only 149 can be selected finally under the law for construction work with 1942 funds.

Thirty-six new seaplane bases have been installed under a joint program of the CAA and the National Youth Administration since January 1.

The British are coming. First group of flight students arrive in Florida to attend Riddle Aeronautical Institute.

Mass production is right. These are new Ryan PT-21's about to go into service at the various primary training centers.

AAF Ferry Command

The United States Army has assumed formal command of the delivery of war planes from U. S. plants to Atlantic Coast points for flight or shipment to Britain. The "Ferry Command" is under the direction of Col. Robert Olds of the Army Air Force, a veteran long range bomber pilot. Civilian pilots are being used until sufficient Army pilots can be assigned.

Washington was speculating as this was written on how long it would be before Air Force pilots would be flying planes outside the continental limits of the U. S. for delivery to belligerents.

Five separate airlines are operating, or are projected, on the Atlantic: Britain to Baltimore; Britain to Montreal; Pan American to Horta; Army from Bolling Field to England; probably the other will be Navy to Iceland. The first Consolidated B-24 was received in England the other day with enthusiasm. It arrived "off Ireland" in 7½ hours.

Bombers flying to Britain are carrying substantial cargoes of concentrated foods, medicines, strategic parts and planes; this service will increase, and it will furnish valuable experience for freight operations after the war.

CPT Spring Session Shows Greater Safety

Washington (AVIATION Bureau)—Accidents in the pilot training program of the CAA were again reduced in the spring session just completed.

With 30,694 enrollees in seven types of courses, there were two accidents involving hospitalization of trainees, four more where they received minor injuries, and only three fatalities.

This total is less than one-third the number recorded for the preceding fall session, when enrollment was approximately the same, reaching 30,798. In that period, there were 10 trainees killed, four hospitalized and 14 who suffered minor injuries.

Women in Air Defense

Participation of women in air defense is receiving more serious attention as demands increase for aviation personnel.

Jacqueline Cochran's flight of a bomber to Britain resulted in plans for a special women's division of the Ferry service and the new civilian air defense program is stressing the value of women pilots in non-combatant duty as in Britain.

The Ninety-Nines are busy building up a record of qualified lady flyers in preparation for emergency need.

Meanwhile the Department of Labor recently reported that women are suited to many aircraft factory operations such as metal fabrication, assembly, welding. In Germany and Great Britain, according to the agency, 40 to 50 percent of aircraft workers are women.

SPOT CHECKING

Power for aluminum production in the South is being stepped up through a consumer saving plan devised by the Army and TVA. Here's the plan: It takes 10 k.w. to make a pound of aluminum, or 100,000 k.w. to a 10,000 pound airplane. Each community in TVA territory which saves its allotment of k.w. hours will have a military airplane named after it and will get a certificate signed by the Chief of the Army Air Forces. The allotments were worked out on a sliding scale paralleling population differences. The saving period runs from July 1 to October 1.

World's largest model meet was first week of July in Chicago. Academy of Model Aeronautics division of NAA, attracted 1280 contestants from all States, Canada, Mexico, and 40,000 spectators in one day. Henry Struck, 24, Jackson Heights, won the championship.

"Eagle Nest Flight Center" has been established by TWA at Albuquerque to train junior Army pilots and civilians for the Ferry Command and to take bombers over the Atlantic. About 800 persons will be involved. Government has assigned undisclosed number of 4-engine Boeings and Consolidateds, 2-engine "Hudson" and North American single-engine Harvards for the job. Capt. Otis Bryan, TWA chief pilot is in charge.

Platt-LePage. Eddystone, Pa., has its helicopter in the air. Observers say it has two rotors, cost the Army $300,000.

Kellet Autogiro is building two 2800 pound giros for the Army, said to carry 1000 pounds pay load. We hear they will go to convoy service rather than reconnaissance as intended.

Three Aeronca joined the 120 Observation Squadron at Biggs Field to participate in maneuvers of the Army. Aeronca says they can do the job of planes now in use costing 15 times as much.

Several recent aviation observers in South America say those countries offer numerous opportunities for the Yerex TACA type of passenger cargo development in Central America.

Difficulties of subcontracting of parts shows up again as Army authorizes Martin to build its own turrets, formerly sub-contracted.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Passamaquoddy to Walla Walla

Months ago, we reported total absence of any special effort by defense workers here. With the country now practically at war, it's the same, with some noteble exceptions. Many high executives work long and hard, but most bureau chiefs, clerks, steuographers fall out the door when the bell rings—at 3:30 to 4:30 in the afternoon. If the country at large could see it, there would be a squawk you could hear from Passamaquoddy to Walla Walla.

The Stubblefield award goes to the Government of the United States. A man from a certain embassy here required three days to find some simple facts about airlines in the Philippines. He went the rounds of Army, Navy, State Departments, and CAA. The Philippines are on one of the war hot spots of the world, and are dependent on the U. S.

Some aviation writers wonder whether, after the Germans have shot down any given model of American-made plane, the War Department will release information on that model for publication.

South Atlantic ferrying of U.S. planes from the "hump" of Brazil to Africa for the British (1800 miles) started two or three months ago. Some of the two-engine civil planes rounded up by the President went that way. Probably many of the shorter range type will go that route from now on.

U.S. Air Force Ferry Command will gradually expand, as the Government becomes more aggressive against the Nazis, beyond the limits of the United States. To relieve more pilots for British combat, deliveries might even be made across Africa to the East. If Russia gets American planes there will be a new ferry route via Alaska to Siberia.

Don't get the chills when Nazi dive Stukas are mentioned. The United States has at least five divers that can outperform the four-year-old German Terror, Curtis SBC2-1, Brewster 340, Vought-Sikorsky 156, Republic Guardsman, and the Douglas SBD-1. Aero Chamber says their average maximum speed is 282 m.p.h.; average cruising range 1300 miles, average bomb load more than 1000 lb. This is far better than performance of the Junkers Ju 87-B (Stuka).

Mr. X, referred to by the President in releasing telegrams between Jesse Jones and OPM Priorities executives, is Max Fleischman, the big yeast man. Mr. X refused to turn in his Lockheed 18 in response to the Administrations call for two-engined planes for Britain. In last issue, this column mistakenly inferred that Frank Gannett, publisher, had refused to deliver his smaller Lockheed. The Government had not asked him for it at that time. Our apology, though unsolicited, to Mr. Gannett.

Army's air force reorganization is regarded by many separate-air-power proponents as a compromise, and they will continue to fight for a completely independent air command. They do not believe the President will intercede for them, and they will bring pressure on Congress through public opinion. The prospect is so uncertain that predictions are useless, and there's no betting money in sight on either side.

Air Youth Scholarships

Winner of first place in the national scholarship competition sponsored by Air Youth of America was Donald H Coles, of St. Paul, Minn. He will receive two years training in aeronautical engineering with expenses paid at the Boeing School at Oakland, California. Winners of the two other scholarships are: Herman O Eley, Jr., of Newton, Mississippi, who will attend the Spartan School of Aeronautics at Tulsa, Oklahoma, and Benjamin Chalmers, Jr., of Springfield, Massachusetts, awarded a scholarship at the Casey Jones School, Newark, New Jersey.

Air Defense Plans

Washington (AVIATION Bureau)—Private flying, from coast to coast, is pleased with the appointment of a committee by Mayor Fiorello H La Guardia, U. S. Director of Civilian Defense, to outline a program of participation by private owners and pilots in the civilian defense program now being organized under his direction.

At this printing the Committee had met in New York and formulated plans and LaGuardia was ready to consider them. Members of the Committee are: Capt Gill Robb Wilson, President of NAA, chairman; Thomas H Beck; and Guy P Gannett.

The plan, which may be much changed, calls for national organization of a Civil Air Defense Service with a wing in each State, following the general pattern of the Army Air Corps.

Most private flyers believe they must make themselves useful to defense or else production of small planes may be stopped entirely. Complete stoppage of private flying has been suggested in Washington, as a precaution against spying.

Meanwhile, Brig Gen. John C McDonnell of the Interceptor Command, First Air Force, announced that information centers, from which team work of general air defense in the industrial and dense population areas will be directed, have been set up.

Big Bombers

Continued from page 133

probably fly in the fall.

Except for the contract with Ford, who is to build 85 Consolidated B-24s a month, not much has yet come out as to automotive participation in the big bomber program. However it is clear that contracts so far announced represent only a part of the 500-a month objective. It now involves operations at Ford's Ypsilanti plant, Boeing's Wichita, Douglas's Long Beach, and Lockheed's Vega plant. Further expansion will bring the auto firms in more prominently.

It may be that this phase is waiting on first results of automotive manufacture of sub assemblies for the mid-western assembly plants. Although they have given up talking about it, some plane manufacturers are still very sceptical as to that experiment, think they may yet find themselves doing all the work.

NEW IDEA in parachutes which has been developed by Dr. Christian A. Veif (AVIATION, July, 1941, p. 127) eliminates usual pilot 'chute. By means of inverted cone rate of descent is said to be decreased.

CALLING NAMES

Joe M. Chapman, formerly with Aero Insurance Underwriters is now associated with the Los Angeles office of Associated Aviation Underwriters.

Eric Nicol is appointed Civilian Adviser on Industrial Relations to **Lt. Col. Charles E Branshaw** at the North American Aviation plant.

Charles A. Arens of Arens Controls takes on duties of sales manager in addition to his designing and development activities. **Calhoun Norton** continues as vice president and is appointed general manager. **Richard Frost**, onetime maintenance engineer for Pan American, becomes new chief engineer.

Edward H. Butler and **John W. Farley** are elected to the board of directors of American Airlines.

A. J. Leonard, Ryan Aeronautical a former purchasing agent, is now with Harvey Machine Co.

Russell S. Paifer wins new Piper Cub on "Wings of Destiny" program.

Maj. Gen. Frank M. Andrews flies to Argentina as representative of **Gen. George C. Marshall** at celebration of Argentine independence anniversary.

F. G. Malhenf of American Airlines is promoted to assistant to manager **J. H. Thelig** of agency and foreign department. **Norman L. Hess** succeeds him as city sales manager at Indianapolis.

Merrill C. Meigs is visiting British airplane plants to arrange for better coordination of aircraft output.

2nd Lt. Fred H. Highley parachuted from a disabled glider, is first Glider Caterpillar in Caterpillar Club.

Brig. Gen. Henry W. Harms is assigned Commanding General of Newfoundland Base Command.

Burton Dedmon, Braniff Airways transportation agent and **Eleanor Waner**, Braniff hostess say "I do."

Carl B Squier, T. B. Herndon, and **William Stoot** are elected NAA directors for a 1-year term. **Berry Bruce** for a 2 year term. **Richard H. Depew, Jr** and **Albert I. Lodwick** for a 3-year term.

Mayor F. H. LaGuardia names **Gov. Arthur H. James** of Pennsylvania Federal Director of Civilian Defense for that state. **James M. Landis, Frank D'Elier** and **Raymond J. Kelly** respectively Regional Defense Directors of First Corps Area, Boston Second Corps Area, New York and Sixth Corps Area Chicago.

W. L. Schneider is appointed vice president of Falk Corporation, **T. F. Scannell**, sales manager, and **J. B. Kelley**, assistant sales manager.

Allan Jackson, vice president of Standard Oil of Indiana retires from active duty. In 1927 he directed the company's purchase of the first of three "Stanolind" planes, and was active in promoting airport development.

Twelve Air Corps officers from Wright Field have completed a 3 weeks course in glider flying training, and the Air Corps has ordered a small number of gliders to continue the experimental work.

U. S. Weather Bureau celebrated its golden anniversary as a civil service agency on July 1st. Cost of services to taxpayers about $7,000,000 a year, and Bureau officials estimate annual savings to nation as running into billions.

A.A.R. Hartsinck has severed his connection with G M & L Henis Corporation.

Clyde DeLong is named operating manager of the mechanical sales division of B F Goodrich Co. succeeding **F. A. Lang**, transferred to managership of heel and shoe sales.

Col. Henry Breckenridge is elected chairman of the board of directors of Dowty Equipment Corp. as announced by President **A. E. Ulmann.**

Victor Kayne is chief of the control tower of the new Washington National Airport.

Father Potter, Augustinian monk, is also **Lt. Paul C Potter**, chief of meteorological instruction at Moffett Field.

Edmund B Walker is promoted to assistant general manager of Federa Manufacturing Co.

R B Headden is promoted to executive v.p. of Purolator Products, **S Letzler** to v.p. and comptroller, **P P Berman** to v.p. in charge of equipment sales, **J. M. Clarke** to v.p. in charge of distributor sales, **L. W Williams** to v.p. in charge of engineering, and **Jules Kovacs** to chief engineer.

Leland Jamieson, Eastern Air Lines pilot who was widely known for his books and magazine articles, died on July 4 at Jacksonville, Fla.

Miss Eileen Wood flew her Cub Trainer to Roosevelt Field from Detroit, and home again.

W. C. Devereux is Controller of North American Aircraft Supply recently created to speed U.S. aircraft deliveries to Britain.

Donald H. Coles, 17 of St. Paul, wins the national scholarship sponsored by Air Youth of America with his model plane. **Herman O Eley, Jr** of Newton Miss. and **Benjamin Chalmers, Jr.**, of Springfield Mass., as runnersup also receive training school scholarships.

Joel Whitney is appointed Registrar of the Ryan School of Aeronautics.

Fred Ford, formerly sales engineer is made purchasing agent, Ryan Aeronautical Company.

B. F Edge is appointed materials co-ordinator Kinner Motors, Inc.

Lawrence C Ames resigns as director of Lockheed.

H. V. Schwalenberg is factory manager of the North American's Kansas City plant. **Carlton Wolf** and **Edwin Monroe** are division engineer and production manager respectively.

Frank Der Yuen, Chinese M.I.T. graduate is appointed general manager of the Harlow Aircraft Co. by **E. M. Allison**, president, who flew Chiang Kai-Shek's private Douglas transport.

2nd Lt. C. J. Haras resigns as a commissioned officer of the Air Corps to re-enlist as a flying cadet.

Coming Events

- Aug 17–18 Sheldon Air Show Sheldon Aeronautics Club Sheldon, Iowa.
- Aug 25–Sept. 2 Third Annual American Open Soaring Contest, Joliet, Ill.
- Aug. 29–31 Aero Medical Association 13th Annual Meeting Boston, Mass.
- Sept. 17–19 National Petroleum Association 49th Annual Meeting, Hotel Traymore, Atlantic City, N. J.
- Oct. 2–4 National Association of State Aviation Officials, Annual Convention Providence R. I.
- Oct. 23–24 SAE National Fuels & Lubricants Meeting Mayo Hotel Tulsa, Oklahoma.
- Oct. 30–31 & Nov. 1 SAE National Aircraft Production Meeting (and Engineering Display), Biltmore Hotel, Los Angeles, Calif.
- Nov 4–6 West Coast Transportation & Maintenance Meeting, San Francisco Calif.
- Nov 12–14 SAE National Transportation and Maintenance Meeting, Statler Hotel Cleveland Ohio.
- Jan 9–11 14th Annual All American Air Maneuvers at International Airport, Miami Florida.
- Jan. 12–16 1942 SAE Annual Meeting (and Engineering Display), Book Cadillac Hotel Detroit, Mich.

United Statea Land Air Power Reorganized "Army Air Forcea" Headed by General Arnold

Reorganization of the Army Air Corps consolidates all military aviation activities under a new unit named "The Army Air Forces" and creates an "Air Council" ta coordinata major aviation projects with other branches of the Army and to pass on mattars of currant aviation policy.

Briefly, Army aviation before reorganization was divided into (1) the GHQ air force, a combat organization reporting to the GHQ—which commanded all field armies, ground as well as air—and (2) the Air Corps, a so-called servicing organization in charge of procurement, maintenance, etc., reporting to the Chief of Staff.

Under reorganization, these two are united under one command—"The Army Air Forces," headed by Maj. Gen. Henry "Hap" Arnold, responsible directly to the Chief of Staff. While the Air Corps retains the same name and duties, the old GHQ air force has been renamed "The Air Force Combat Command." Maj. Gen. George H. Brett and Lt. Gen. Delos Emmons continue as head of these organizations, respectively.

At the same time, aviation is withdrawn from under the command of the Army GHQ and a separata "GMQ" has been set up for aviation—the "Headquarters Army Air Forces." This organization is headed by Gen. Arnold with the aid of an "Air Staff," modeled in general after the War Department General Staff, to serve as the coordinating and operating group for the unified Air Forces. Brig. Gen. Carl Spaatz, acting as adviser and executive assistant to Gen. Arnold, heads the Air Staff.

Thus aviation is placed on an autonomous status within the structure of the War Department.

British "Locator" ia Resisting Night Bombing

It is possible that Britain's new "radiolocator," a device to find and aim at enemy aircraft, may bring about important changes in aerial war strategy. Last winter, Sir Hugh Dowding, R.A.F. Commander, told reporters in a crowded Washington hotel room that his government was nearing perfection of a means of stopping night bombing by the Nazis. The device has been turned over to the U. S. Army.

The locator works on the microwave band of the radio spectrum. Radio emanations of this class are quasi-optical, and they can be focused. The transmitter scouts the air space where enemy aircraft are suspected. When it catches one, or more, the wave echoes back. The orientation of the transmitter gives the line on which the plane is located. Triangulation on a reading from a second locator gives the exact position. Repeated "readings" give the course of the plane or planes. Then, when the enemy comes close enough, the locator enables AA guns to take aim at individual planes without seeing them.

The British no longer hope, as they did, that it will stop night raiding, but they feel sure it will bring about drastic curtailment.

United States Navy Moves Into Iceland

United States forces in Iceland are within long-range bombing attack by the Nazis. Although Hitler claimed no intentions toward this Danish outpost, he was mighty mad when FDR moved in, and many persons believe this island may be the scene of the first armed clash of the United States in this war.

Iceland was taken to keep the Germans from taking it first as a base of operations against Atlantic shipping and as a springboard against the western hemisphere. And it was taken as an Anglo-American base of attack against Nazi subs and bombers over the Atlantic. It was a heavy blow by the Allies in the battle of the Atlantic.

Incidentally, the move made possible the release of some 75,000 British troops for service elsewhere.

The British have two large airports on Iceland, and probably the U. S. will build more. Reports from London indicated, immediately after the occupation, that the United States would establish air service to Iceland. Any such airline probably would be Navy, not Army. The climate of Iceland, unlike that of Greenland, is moderate, and harbors are tenable the year around.

Atlantic Air Route by U. S. Air Force

The new trans-Atlantic air service directed by Col. Robert Olds, head of the Army's Ferry Command, was set up primarily to facilitate the quick return from England of American ferry pilots, and to carry official personnel and documents back and forth across the ocean.

Operated non-commercially over secret routes, daily flights are anticipated. Reportedly the Air Corps is using demilitarized Boeing Flying Fortresses. The American terminus appears to be Bolling Field, at Washington, at least part of the time.

$16,000,000 for Gasbags and Aircraft Experiment

Congress early this month passed a bill authorizing $16 million in lighter-than-air facilities for the Navy, re-establishment of the Naval Air Station at Moffett Field, Cal., and $100,000 for experimentation in fields other than standard heavier-than-air craft.

The new facilities will accommodate the 42 blimps already authorized and under construction, intended for coastal observation duty, and will be located at Norfolk, Va., Cape Hatteras, N. C., Boston and various undesignated points.

The same measure authorizes $6,500,000 for the Army to replace Army air training facilities now located at Moffett Field.

The aeronautical experiments provided in the bill may include such craft as "rotary-wing type aircraft, gliders, metal-hulled and other than conventionally propelled lighter-than-air craft".

Tangle Them Up

Barrage balloons for defense against dive bombers will go to the Panama Canal, Hawaii, and vital continental industrial areas. War Department estimates that 1,000 barrage balloons are needed. It expects to pay about $6,000 apiece. Experience in Britain is that the dangling cables distinctly retard low flying.

AAF Trains Glide Men

Twelve Army Air Force officers have finished a three-week course in flying two, eight, and 15-place gliders. The training was experimental. The Air Force as yet has no established policy on gliding as a military tactic.

It is said unofficially that the Air Force has three Schweizers, three Cinemas, and four troop-carrying gliders of eight or 15 places. Orders have been placed for 30 planes.

National Steel Car To Build B-26's

The Canadian government has placed a $25,000,000 order with the National Steel Car Limited for construction of Martin B-26 "Flying Torpedo's" at their Malton plant. It was announced that engines, propellers and instruments were not included in the order and that they would be supplied by other plants in Canada. Powered by two R-2800 Pratt & Whitney engines driving four bladed propellers of advanced design, the airplane weighs over 13 tons and is said to be the heaviest armed ship of its type.

Pipers Can Fight

Performances of a fleet of seven Piper Cubs in recent military maneuvers in Tennessee indicates possible use of light commercial planes as behind-the-line observers for artillery and infantry.

GROUND VIEW of the new Curtiss Kittyhawk which is now being produced in large numbers for the R.A.F. by Curtiss-Wright's Buffalo plant, is the export version of Army's P-40D.

Hillman Trying Regional Labor Agreements Shaped on Those of Shipbuilding Industry

Washington (AVIATION Bureau): Negotiation of regional labor stabilization agreements in the aircraft industry, predicted some months ago, is now under way. Objective, as in the shipyard agreements where the idea was first tried, is to eliminate labor raiding by standardizing conditions and wages throughout the industry. The aircraft plan goes considerably farther, however, in that it is designed substantially to raise wage levels—very likely up to the standards prevailing in the auto industry.

The stabilization agreements, which are a rather radical new departure in labor relations, are the brain-children of Sidney Hillman's labor division of the Office of Production Management. What they involve is that all the employers in a particular region and industry sit down with representatives of labor and government and—by a process of three-sided bargaining—arrive at a labor relations contract which is supposed to cover all firms in the region.

This has already been tried once—for the shipbuilding industry. Using a rather gradual approach, the shipyard agreement merely established model clauses which the participants were expected to incorporate in actual contracts. Wage rates were set slightly below the very highest prevailing in the industry. The general principle received a great boost when the two hold-outs in the West Coast region—the Bethlehem yards and the San Francisco machinists—capitulated.

Encouraged by this success, Hillman is determined to make the aircraft agreement much more sweeping. In the first place it is to be a definite contract rather than merely a recommendation for a contract. And it will go far beyond simply standardizing wages as between different plants. The definite objective is to raise the wage standards up to a level comparable with those in the auto industry—where 85- and 90-cent minimum wages are not uncommon.

The unions' organizational drives in aircraft have been built around the assertion that aircraft wages are considerably below those in the comparable automobile industry. Hillman feels that as long as this condition obtains there is going to be constant strife and stoppages—that in the interests of uninterrupted production the whole jump might as well be taken at once. It is believed this will involve an increase of perhaps $250,000,000 in aviation payrolls.

Though Hillman's office does not admit it, it seems probable that universal unionization of the industry, perhaps a universal closed shop, is a likely outcome of the scheme.

Until recently most employers in the industry were decidedly cool to the plan. They have been subjected however to great pressure from Hillman, who is prepared to use all his powers as associate director of OPM to put through his plan. Most now consider some such arrangement as inevitable.

Paradoxically, most remaining opposition to the scheme comes from the labor side. The situation is complicated by the number of unions, with overlapping jurisdictions, which are seeking to organize aircraft. These include the AFL machinists (operating on an industrial basis) and patternmakers, the CIO auto workers, and the independent aircraft welders. The AFL has endorsed the stabilization plan, but the CIO is cool to it.

Curtiss Propeller's New Indiana Plant

Production has begun in Curtiss-Wright's fourth plant at Indianapolis, Ind., where the 400,000 sq. ft. former Marmon factory is being devoted to Curtiss electric propellers. A total area of about 1,000,000 sq. ft. is now producing propellers for the National Defense according to Robert L. Earle, vice president of the corporation and general manager of its propeller division.

New Indiana unit is located on a site of 14 acres a short distance from downtown section of Indianapolis and comprises three buildings. In less than five months new lighting, heating and plumbing systems were installed and sufficient machine tools set up to permit the start of production on June 30th. Plant is manufacturing hubs, hub nuts, blade gears, adapter plates, brush housings and caps and a number of other small parts for the completed propeller as well as assembling Curtiss electric propellers made in the three other plants.

NAC's Moffett Field Lab

Work is being rushed on the Ames Laboratory of the National Advisory Committee for Aeronautics, at Moffett Field, Calif. Costing $10,000,000 to build, the laboratory already has 170 employees at work, a figure to be expanded rapidly in the next few months. One of the new wind tunnels under construction will generate speeds of 600 m.p.h.

Douglas Dive Bomber

Douglas is now in quantity production in its El Segundo plant on the A-24 dive bomber, which is an Army version of the well known Navy Douglas SBD-3 dive bomber. Increased emphasis on dive bombing is reported scheduled for the Army Air Corps, with one complete Air Force combat command group to be equipped with the new A-24 bombers now being delivered. Load carrying capacity, performance and armament of the A-24s is said to exceed any such plane in service overseas.

Douglas deliveries of military airplanes in June were 30 percent ahead of May, compared with a national gain of but 10 percent. This is particularly gratifying because Douglas produces only combat type planes of relatively heavy class, including the "Havoc", or A-20-A, which is now going into service both here and in England in considerable numbers.

Franklin's experimental float, all with Franklin engines. Ships include Bellanca, Culver, Stinson, Manganupe, Taylorcraft, Piper, Aeronca.

Special 2S Silvaire

Weighing 1310 lb. gross weight, the new Luscombe Silvaire, Model 8D-I, designed especially for the CPTP, has a cruising range of 500 miles, a considerable increase over the previous range of about 350 miles.

Powered by a 75 hp. dual ignition Continental injector engine, the new model has two 12-gal fuel tanks in the wings. Special provision is made for the installation of two-way radio and full blind flying instruments. Because of its economical operation, high useful load of 800 lb., and long range, the new Silvaire should be of special interest to operators engaged in the cross-country phase of the CPTP secondary course.

More Alcoa Expansions

The Vernon works of Aluminum Company of America in Los Angeles, Calif., has just completed new buildings to house additional fabricating facilities, an expansion of 455 percent since Germany overran Poland in the fall of 1939. New facilities include an extrusion works and a rivet plant, as well as additions and betterments to the existing aluminum foundry and forge plant.

Alcoa's Lafayette, Ind., works, also a fairly new plant, has increased floor space from 287,000 sq. ft. in Jan. 1939 to 1,471,000 sq. ft., an increase of 413 percent, which will be completed by October this year.

Expansions and improvements at Los Angeles and Lafayette are part of company's self-financed $200,000,000 expansion program undertaken to supply defense industries with aluminum ingot and fabricated products.

Sperry's New Plant

With Army, Navy and Civil Officials participating, ground was broken on July 8, at the site of the Lakeville, Long Island plant of the Sperry Gyroscope Company.

The plant will include 1,350,000 sq. ft. of floor space, placing 28 acres under one roof. The factory building will be one story, 1440 ft. by 840 ft. and, in addition, there will be a three-story administration building. About 7000 new employees will build aeronautical and

marine instruments in the new plant, which will be constructed under an arrangement with the Defense Plant Corporation of the Reconstruction Finance Corporation. The plant will be the property of the DPC and will be leased by Sperry

Air Associates Adds New Building

Ground has been broken for an addition to Air Associates, main plant at Bendix Airport, Bendix, N. J., which will comprise about 70,000 sq. ft. The new construction is expected to be ready for use by October 15, 1941.

Since last October, company has started construction of a quarter-million dollar plant at Los Angeles Airport to replace its present operation at Glendale, Calif., and has also acquired the former Fokker plant at Bendix, N. J. on a long-term lease

Suprex Gage Company

N. A. Woodworth, founder of Ex-Cell-O Corp. in 1919, has organized the Suprex Gage Co. at Pleasant Ridge, Mich., for the manufacture of plug and ring gages, thread plug gages and various other types with Carboloy facing.

With new equipment throughout, including the most modern temperature control apparatus, Suprex is also equipped to salvage all types of gages by hard chrome plating. New company will have William F. Klemm as general manager, formerly associated with Woodworth at Ex-Cell-O.

Promotions at Aviation Mfg. Corp.

Former executive vice president William F. Wise is made president of both Aviation Mfg. Corp. and American Propeller Corp., the latter a new subsidiary of Aviation Mfg. which manufactures hollow-steel propellers. He succeeds Harry Woodhead, new board chairman. William K. Cooper, former general mgr. of Lycoming, is gen. sales mgr. of Aviation Mfg. and a director of Aviation Mfg. and American Propeller. P. E. Gerlent, plant mgr. at Lycoming, comes from Federal Mogul. C. O. Samuelson becomes sales mgr. of Lycoming. William B. Griese, supt. at Lycoming, replaces W. E. John, transferred to American Propeller.

ASSEMBLY LINES

By Robert Colbert

June plane production of 1,476 is 150 above the low May figure and within a few units of the 1,500 quota set for June late last summer. The North American strike that month reduced output by some 70 planes, mostly advanced trainers.

Foreign production figures tend to be 50 percent guess work, but best available guesses suggest a world production of something like 8,000 planes a month, divided thus: Germany, 2,500; Russia, 2,000; Britain, 1,800; U.S., 1,500; Japan, 300; Italy, none except parts, small amounts in British dominions and non-German Europe.

Limit on U.S. production at present appears to be not so much capacity for airframes or engines, as it is minor parts and accessories and propellers. Many plants now have substantial quantities of planes on hand finished except for some essential part.

Martin, for instance, recently had more than 50 B-26 medium bombers stacked out waiting for propellers and turrets.

Export figures on aircraft are deliberately delayed even beyond the holdups normally to be expected of statisticians. It's still news that in April, when 1,427 plans were built, we exported 591, a hundred above the previous month. Also 700 engines were exported, 300 less than in March.

Correct model of the Curtis P-40 pursuit mounts a 37-mm cannon, firing through the prop. Other armament consists of two 0.50 caliber machine guns in the nose and four 0.30 cal. in the wings.

Next model of the P-40, reportedly, will be powered with a Rolls-Royce engine.

Packard is scheduled to be producing Rolls Royces soon. Original plan to build the 1,200-hp. Merlin was changed midway, and the engine to be produced will be the improved Rolls V-12 of about 1,600 hp. Some thought was given to building the Rolls Valture, an X-24 of some 2,000 hp., but it was decided this would involve too much re-tooling and delay production excessively.

Definite decision has finally been reached not to build Britain's other 2,000-hp. engine, the Napier Sabre, in this country either. As previously reported, this has been under consideration for several months.

Start of production on the Baltimore medium bomber for the British gives Martin two ships of this class in production. Output of the Baltimore will be substantially stepped up with completion, probably this month, of Plant 2 at Middle River. Manufacture of the B-26 will be shifted to the new plant and present space devoted to the Baltimore.

The Baltimore, otherwise known as the "187" is a twin-engine ship, faster than the B-25, which was hailed a few months ago as the fastest bomber ever built. The Baltimore is lighter and has a considerably smaller bomb capacity. It's a mid-wing monoplane powered by Wright 1,200-hp. R-2600 engines. (The B-25 has the 2,000-hp. P&W.) The Baltimore is built to British specifications and has the narrow deep-waisted fuselage characteristic of British bombers.

Useful loads equal to half the gross weight is foreseen for the planes of the future by Juan Trippe of PanAm.

Test flights of Lockheed's Vega Venture, the British bomber succeeding the Hudson, are scheduled for August, with mass production coming right along behind. This ship is a military version of the Lodestar transport, as the Hudson was of the Model 14.

Trainer manufacture at North American's Inglewood plant will stop in mid-October and be transferred to the new Dallas factory. Inglewood will be devoted to building pursuits and medium bombers. Since 1936, more than 3,500 trainers have been built at Inglewood.

Navy, at the beginning of June owned 3,342 planes of all types. Deliveries to the Navy first four months of this year totaled 992, of which 500 were combat types. Navy orders no longer have the highest aircraft priorities.

Howard Hughes' Culver City experimental plant went into operation in July. This plant will have 250,000 sq.ft. almost entirely for development work. Military types in development are said to include both pursuit and bombardment, which, when accepted, will be produced by other manufacturers.

Sreoope, Engineering & Research Corp.'s gyroproof light plane, can no longer be built as an all-metal because of inability to obtain aluminum. Probability is that next 250 ships built will retain an aluminum central fuselage (for which inventories are sufficient), with the rear fuselage of plywood, wing skeleton and landing gear of steel, control surfaces of wood, fabric covered. Geometry of the ship is being held the same to permit interchangeability of wings and the like with older models.

Light planes of current types, if built in real quantities, would only cost $800, according to W. T. Piper. Entire light plane industry, if worked to capacity, could turn out about 20,000 ships a year without plant expansion.

Some people think that if the Army would buy a lot it might break the vicious circle of high prices-low volume, low volume-high prices.

A plastic-beaded plywood trainer is to be built by Fletcher Aviation Co., which has acquired a 30,000-sq.ft. plant at Pasadena.

Porterfield Airplane Co. has changed its name to Columbia Aircraft Corp.

TO MEET NEW CAA REGULATION that all planes flying on Civil Airways at 3500 ft. or higher must be equipped with two-way radio, Electronic Specialty Co., Glendale, Calif., has a new self-contained transmitter, Model T4A, designated as a matching unit to the Ranger Beacon receiver. Case measures 4½x5½x8 in., is light in weight and low in cost.

Sperry-Hoover Tie-up

Consolidated Engineering Corp. of Pasadena will take over the work of Sperry Gyroscope in vibration and strain measuring equipment.

Principals of the two companies who signed the agreement were Herbert Hoover, Jr., President, and E. E. Huskins, Chief Engineer, of Consolidated; and President R. E. Gillmor, Preston Bassett and R. B. Lee, Vice Presidents of Sperry.

"Several weeks ago Consolidated Engineering Corp. offered to help us" said Mr. Gillmor. "We are glad to announce that details have been worked out by which we will avail ourselves of aid from this well qualified concern. Sperry pioneered the field of vibration and strain measuring equipment. The first units were developed in 1935 by Dr. C. S. Draper, M.I.T. consultant to the Sperry Gyroscope Co. Since then this equipment has found widespread application in the aviation industry."

HAROLD H. McMAHON, formerly specifications engineer with the Allison Division of General Motors Corp., has resigned to join Menasco Mfg. Co. in Burbank, Calif., where he has been given charge of experimental and development work on a new Menasco engine.

Poulsen-Nardon Expands

Latest aircraft accessory maker in the Los Angeles area to stage a major plant expansion is Poulsen Nardon, Inc., maker of cable terminals used on nearly seventy-five percent of all American aircraft, and of other electrical equipment such as junction boxes and electrical hardware. The new Poulsen-Nardon plant provides 21,000 sq. ft. of additional plant capacity and makes possible production of 4,000,000 cable terminal units per month. The company is also manufacturing leakproof aircraft fuel tanks.

Dutch Harbor Airbase

Spurred on by the Russo-German war, the Navy is rushing to complete its aviation facilities in Alaska and expects to commission the new Naval air station at Dutch Harbor on the Aleution Islands by September first.

Dutch Harbor is considered a particularly strategic defense outpost because of the Russian bases in Siberia—only 30 miles from western Alaska—said to have been built by the Russians under the supervision of Nazi technicians.

The Civil Aeronautics Authority meanwhile awarded $120,840 in contracts for construction at six Alaskan airports, to facilitate air communications in this area.

The Navy is also anticipating completion of air bases at Midway Island and Trinidad during the summer.

Promoted by Aviation Mfg. Corp.: l. to r. William F. Wise, William K. Cooper, P. E. Gerlent, C. O. Samuelson, William B. Griese.

Canadian Aviation News

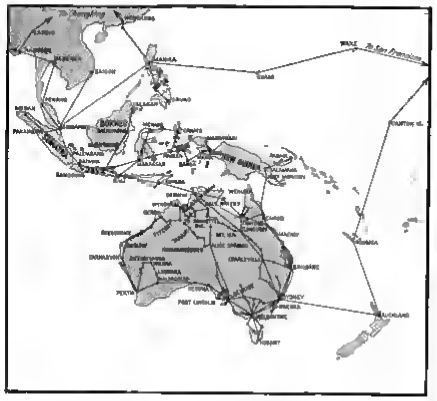
By James Montagnes

Trans-Canada Airlines, the publicly-owned transcontinental air service, is now flying 20,000 miles daily in scheduled services. At the end of 1939 the national air service had a daily mileage of 7,044 and at the close of 1940 the average had jumped to 15,144. The daily schedules now include two from Halifax to Vancouver each way, three each way between Toronto and New York, Toronto and Windsor (Detroit), and five each way between Toronto, Ottawa and Montreal. On the service to Halifax, blackout curtains are drawn across all windows from 20 miles outside the city to the airport, as Halifax is a restricted area. Toronto is now the busiest commercial airport in Canada, with in addition to Trans-Canada Airlines service, new Buffalo-Toronto and services from the northland coming into Malton Airport, Toronto. The runways at Malton Airport are to be enlarged to make them nearly a mile long in all directions.

Trans-Canada Airlines has started its own air express service on all its routes, with ground connections in Canada through the Canadian National Railways express department, and in the United States with the Air Division of the Railway Express Agency. Four girls are being trained at Winnipeg to become passenger agents for TCA, as many of its male passenger agents have been called up for military service.

A $25,000,000 contract has been placed with National Steel Car, Ltd., for the construction of Martin B26 Bombers at the Malton (Toronto) plant of the company, according to an announcement of the Department of Munitions and Supply, Ottawa. The contract cost excludes engines, propellers and instruments. No date has been set as to when deliveries will start.

Four commercial flying schools and four former flying clubs operating as instructor training schools for the Royal Canadian Air Force since August 1940, were closed July 31, 1941, after turning out in the year about 340 instructors for Royal Canadian Air Force elementary flying schools. Instructors handled at these 8 private flying schools had at least 50 hours flying experience before starting their course which covered another 150 hours. Following an examination they received another 30 hours at a Central Flying School at Tranton, Ontario, before being posted as instructors at elementary flying schools. The 8 schools were started to meet an emergency in training instructors.



THE TREMENDOUS DEVELOPMENT of civil aviation in the Far East and especially in Australia can clearly be seen on the map. Australia is fast becoming the center of intercontinental services which branch out to America, Asia, Africa and Europe, maintained by Dutch, English, American and Australian airlines, many using American equipment. A brief description of Australia's air development was in last month's Aviation.

On Schedule

By "Vista"

Prince George Bibesco, one of the "grand old men" of aviation died "suddenly" last month in Bucharest, according to reports received here. President of the Federation Aeronautique Internationale for the past eleven years, Prince Bibesco was 61, a one time pupil of Louis Blériot, French pioneer aviator and airplane builder, and a man with an all encompassing interest in aviation and a far seeing vision into the horrors, and world wide benefits, of the airplane.

More important though is the story which may attain prominence now that the head of the F.A.I. has passed on, a story which came up about four months ago, set off by a heated argument between America's N.A.A., local representative of the F.A.I., and the German Aero Club in Berlin. With the invasion of Paris the offices and records of the F.A.I. were sealed and presumably taken back to Berlin—this action cannot be underestimated in its import and far-reaching effects. These records contain the most accurate and complete story of aviation, its successes and failures that is available at the present time in one file. The F.A.I. was the final judge about all aeronautical records of the 39 or 40 nations connected with it and comprising its membership, each country appointing the national aeronautical organization, and the absolute control of such decisions by Nazi judges would not be without its repercussions and probably general falsifications and favoritism towards Axis records. The N.A.A.'s counter action, which has luckily had success, was a request that the member organizations send all official records to Washington, where they would be safe from partial influence until such a time that the F.A.I. could once again be set up as an independent keeper and unprejudiced judge of vital aviation statistics.

The Atlantic promises to become one of the most crossed oceans in the world when all the plans settle down to actual operations and the various American and English airlines, both commercial, military and diplomatic, start running on the schedules and frequency predicted Juan Trippe, during his address to the Royal Aeronautical Society in London, announced the increase of Pan American's Atlantic trips from three to four and then six, with a 12 hour crossing by super landclippers scheduled for 1942. In addition to the regular flights to Lisbon now in operation, England will operate a service for diplomats, ferry pilots and diplomatic mail to Canada, America reportedly is already operating a military service to a secret airport in England; a second British service will be operated with the Boeing Clippers recently obtained in this country, to Baltimore, probably only once a month with plane overhaul as its main purpose, and the base now available in Iceland will make landplane flights to Scotland possible with the equipment now immediately available, or being requisitioned by the government from airlines in this country. All in all, the large flying boat seems to be losing out in all these actual and proposed operations. The development of the Douglas B-19, the following trips now being made by British craft, both large and small, across the big pond, cannot fail to leave the impression with the general public that, barring monster boats, the landplane is definitely in the ascendency for both over-water and over-land operations.

For the first time since the war began a general cancellation of all German Lufthansa services for all commercial traffic was ordered last June 23rd., the reasons were not announced and only the Zurich-Munich service was opened on July 2nd, with the prospect of resumption on the Berlin-Copenhagen-Stockholm service later last month. Most obvious explanation of this action is the fact that both pilots and planes were urgently needed for ferrying operations on the 2500 mile Eastern battlefront, while only services to vital neutral countries were established as soon as possible. In fact, reports from Sweden state that the Stockholm-Berlin line was being flown only by A.B.A.'s DC-3s, with airplane loads running from 94 percent to 100 percent of capacity.

To become president of Pump Engineering Service Corp. (a Borg-Warner subsidiary), R. J. MINSHALL resigns as vice pres. and director of Boeing Aircraft with which he was associated since 1919

LESSITER C. MILBURN is appointed vice-president and general manager of Bellance Aircraft. Recently works manager at Curtiss-Wright he had been chief engineer at Glenn L. Martin Co.

New laurels for JACQUELINE COCHRAN for successfully ferrying a bomber to England. Now she is organizing American women for service after studying the air activities of British women

McDonnell Aircraft Corp's new vice president, GARDNER W CARR, has been in aviation since 1921—with Boeing from 1922 to 1934, with Glenn L Martin Co., and with Lockheed since 1938.

ALBERT I. LODWICK is newly elected vice-president of Morton Manufacturing Corp., and will also continue to operate his flying schools and to manage Howard Hughes' television activities.

Production of Globe Aircraft Co.'s new low-wing "Swift" monoplane will be supervised by E. J. RIVERS, factory manager. He had been factory manager at North American's Dallas plant

Election of COL. HARRISON W. FLICKINGER (l), director of export sales, and C. HART MILLER (r.), director of military contracts, as vice-presidents of Republic Aviation Corp. is announced by W. Wallace Kellett, board chairman. Col. Flickinger joined the company in 1939 as director of exports, and was made head of the material department in 1941. Miller, with Republic since 1935, became director of military contracts in 1940.

Here is ROBERT ALEXANDER WATSON WATT, the Scottish scientist to whom is credited the development of Britain's secret radio "plane detectors" Radio technicians are wanted as operators

The trophy and medal of the International League of Aviators has been awarded to COL. ROBERT OLDS, for his command of Flying Fortress squadrons on goodwill trips to South America in 1938 1939.

JUAN T. TRIPPE flew to London to personally deliver the 29th Wilbur Wright Memorial Lecture, at the invitation of Britain's Royal Aeronautical Society. The subject of his address: Ocean Air Transport.

TWA has placed Capt. OTIS F. BRYAN in charge of its special training division at Albuquerque, where pilots will be trained for ferry command and for British transatlantic service

J. GRIFFITH BOARDMAN, elected a director of Brewster Aeronautical, was chairman of the Aviation Council for Pennsylvania where he directed the development of airport and radio facilities.

Personnel requirements for Adel Precision Products Corp. will be under the direction of ROBERT S. FURST, new personnel director. Furst was formerly with Spicer Corp and Republic Steel Corp.

PAUL ESKEW, for the past eight years on the executive production staff of Solar Aircraft, is now associated with Aircraft Components where he will serve in a production executive capacity

New Die Casting Process

A new die casting process designed to produce small parts has recently been announced. Gas and watertight closures, jumbo zippers and a wide variety of small parts may be made with hitherto unheard of speed.

Developed by the Crown Fastener Corporation at its Warren, R. I., plant, the process is made possible by ingenious high-speed automatic die casting machines, which individually can produce up to 450 separate die castings per minute. These machines also automatically trim and form a piece after casting so that a part of intricate shape is delivered in finished form from the molten metal by a single machine.

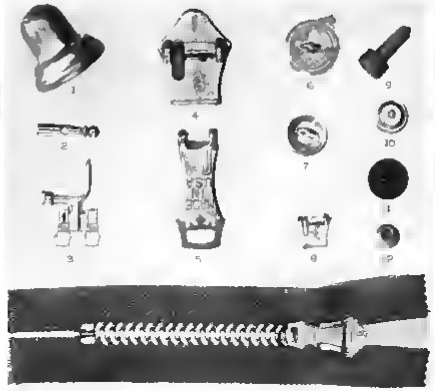
In making zippers, each tooth or scoop is individually die cast directly on to the tape by a die through which the beaded edge of the tape passes. This method of manufacture produces an unusually strong slide fastener as well as one which operates with easy smoothness. A jumbo zipper, larger than any heretofore manufactured, made by the Crown organization, will be used as a closure on aircraft engine and wing covers manufactured for the U. S. Army Air Corps.

Many small parts now made on screw machines, milling machines and automatics requiring substantial machine hours for production and involving wastage of metal in cutting stock to finished form, can be produced at rates of from 35 to 300 per minute by the Crown die casting process.

Aircraft Welding Contest

The Sammerill Tubing Co., Bridgeport, Pa., is establishing a series of prizes to be awarded by the American Welding Society at its Annual Meeting during Oct. 1941, for papers to advance the art of welding of aircraft steels.

Any type of welding which is or can be used for the fabrication of structures or assemblies in aircraft production, such as 1025, X4130, X4135, X4340 or similar steels, may be treated in the papers. Winning papers will receive the following prizes: one $300 prize, one $200 prize and additional prizes totalling $100 to be distributed for such additional papers as the Committee of Awards may direct. Contest is open to any resident of this country without restriction. Further information may be obtained from the American Welding Society, 33 West 39th St., New York, N. Y.



SOME of the many small parts made by the new Crown die casting process. 1. Umbrella Shaft Cap. 2. Umbrella Rib Tip. 3. Rough Casting. 4. #10 Zipper Slider. 5. #10 Zipper Pull. 6. Mattress Button, Rough Casting. 7. Mattress Button, Finished. 8. #5 Zipper Slider. 9. Set Screw. 10. Firing pin for artillery shells. 11. Thumb tack. 12. Rivet. Below is a completed Jumbo zipper showing the use of many of these parts.

Light Plane Engines and Their Fuel Problems

By Carl T. Doman*
Allocated Motors Corporation

With the gradual increase in power requirements for light plane engines, low operating cost becomes more and more important. Many attempts have been made to use automotive gasoline in an airplane. However, these attempts have not been carried to a logical conclusion and the troubles eliminated from the installation, which prevents the use of automotive fuels.

The principal objection to the use of automotive fuels seems to come from the possibility of vapor lock and indefinite knock rating. Perhaps the answer would be to change the specifications of automotive fuels to approach the aviation types. While none of the engines manufactured by my company are approved for automobile fuel, I do want to point out that we have satisfactorily conducted four type tests on automotive fuel with absolutely no trouble. A CAA run was made in November 1940 on our 130 hp six cylinder opposed engine using 80 octane non leaded automotive fuel, obtainable in any city.

It is felt that there is a definite need to have a study made to determine the relation between the knock ratings in test engines and actual light aircraft engines, as there are indications that the knock rating assigned to certain fuels are not correct. We have found ... that several different fuels all rated at 80 octane, for instance, will have entirely different knock characteristics in a production engine. Also it has been found that the knock varies with engine speed, spark advance and mixture ratio, when different makes of fuel are tested under exactly the same conditions.

It is recognized, ... that the higher the compression ratio, the higher the output from a given size engine. Fuel makers have assured the engine builders that the octane rating is gradually increasing. For that reason the engine makers have designed the engines to accommodate higher octane fuels. Recently, however, the light plane engine makers have been faced with the problem of the entire rearrangement of the fuel situation, based on the National emergency. This rearrangement has not gone into effect 100 per cent as yet but fuels of 65, 87 and 100 will be used eventually, eliminating 80, 87 and 95. Under the rearrangement of fuel specifications, 73 octane has a maximum of 1 c.c. of lead, 80 octane 2 c.c.'s of lead and 91 octane has a maximum of 1 c.c. of lead.

To the light plane engine maker this rearrangement of the fuels has resulted in a serious situation where engines were designed and developed to operate on not more than 1 c.c. of lead per gallon. Furthermore, these light plane engines have been designed so that it is not possible to reduce the octane rating without running into a multiplicity of other troubles. Thirty minutes of operation on an engine using 73 octane fuel instead of 80, resulted in a piston cracking. At the same time decided corrosion was present in the cylinder head pocket around the inlet valve. Both of the exhaust valves were badly warped.

The above discussion is not intended in any way to discredit the use of additional lead in aviation gasoline, as we all know it to be necessary, especially in these times of national emergency. There are many approaches to the problem of change in design to permit the use of a lower octane fuel, without sacrificing power. A few of the approaches are as follows:

a) Increased displacement,
b) Improvement in installations in airplanes;
c) Improvement in induction systems, manifolding, etc.;
d) Changes in cam timing;
e) Improved cooling of the cylinder and piston.

*This paper, of which an abstract is printed above, was given before a recent meeting of the Society of Automotive Engineers.

New Engine Test Design

A new engine test house of revolutionary design was put into successful operation recently by the Academy of Aeronautics, LaGuardia Field, New York, for instruction in engine testing.

The six engines are arranged in four cells in the form of a cross with the exhausts all into a central tower or exhaust stack possessing sound deadening or noise absorption qualities resulting from the use of special cinder blocks with lightening holes exposed for baffling purposes. The four control rooms located at each corner of the design have observation windows that enable instructors and students to check engine operations in two adjoining cells.

FDR Takes 12 More DC3 Planes for British
Any More Will Hurt Line Service to Defense

Washington (AVIATION Bureau)—The Administration tentatively promised the airlines, when it took the last 12 DC-3s for the British, that no further demands would be made, barring critical emergency. Opinion here was that the airlines were actually damaged more by the loss than they admitted, and that they had done an excellent job of keeping their tempers and cooperating with the government.

This is what happened: The President, having a new request from the British, wrote Jesse Jones, asking him to round up 24 more airline planes. Jones turned the letter over to CAA boss Bob Hinckley, who called in Colonel Edgar S. Gorrel of the Air Transport Association. Some contention ensued, naturally, when operators met to consider the problem. Finally the Commerce Department concluded that 12 was the outside limit the lines could spare. Lines were allowed to keep the 12 over July 4. Average price allowed was $100,000, each, a figure calculated to cover replacements.

Britain's total take of two-engine planes up to now: last year 43, mostly DC-2's; earlier this year, 20, mostly DC-2's and Lockheeds; early July, 12 DC-3's; total, 75.

The Administration, under great pressure for more planes, was going the limit and facing public criticism for gutting the airlines and the country of needed airplanes. But the bad publicity bounced back on the British themselves, which partly takes the Administration off the hotspot.

The British are criticised for not anticipating their transport needs. Last year Morgenthau, when he was liaison man, urged them to order transports. The British are suspected by some opposition of putting these American planes to use on their own civil service. In answer, Britain requisitioned two Lockheeds from Trans-Canada. But Trans-Canada only recently received six new Lockheeds, and announced new schedules, while U.S. lines are foregoing much needed new schedules. However, claims that Canadian lines had added 22 new ships were denied, even by airline executives.

The airlines, while they refrained from public statements, wanted the War Department to convert Hudson bombers to transports for the British instead of taking the DC-3's. (The Hudson is a conversion from the Lockheed 14 passenger plane.) It takes only five days to convert a Hudson bomber for transport, whereas it takes three weeks to convert a DC-3 to troop transport. Several of the DC-3s transferred were sleepers, which are hard to rip out. Probably 200 Hudson bombers are standing around, awaiting delivery to the British, and it was not clear why some of them were not taken. The only plausible explanation is that the British are desperate for bombers and don't want to give up even a few.

At this writing only two schedules had been canceled as a result of the British requisition. American Airlines' trips 78 and 79, New York-Chicago. It was thought there might be more. The average time of transport equipment in the air was 10-11 hours a day. Operators said they would boost this rate a bit and make out. One of them said that OPM is giving airline maintenance every advantage in priority on parts and tools. No concern was expressed over the safety question.

Operators are down at heart because they are missing this opportunity to make some money, through no fault of their own, while most other business is getting a boom. But they feel that if no more planes are taken, they can get along. By next spring, they hope that aircraft production will have reached a point where the lines can have plenty of equipment to handle regular and defense and vacation travel.

PAA Has Ordered Fleet of Super Clippers
Panagra Relps U. S. Dust Axis Latin Lines

In his recent London speech, J. T. Trippe, president of Pan American Airways, confirmed reports that orders have been placed for a fleet of advanced-type super clippers for the Atlantic service. Outlining the performance requirements of the planes, Mr. Trippe said that the harbor ice problem in winter indicates the advantage of land planes. It was assumed that the Pan American order is for Lockheed four-engine "Constellations".

Other conditions to be met, according to the PAA president, are sea swells, which exceeded three feet on 35 days out of each hundred at Horta; land planes capable of non stop trips would solve that one. High winds require speeds of at least 75 to 100 m.p.h. in excess of present speeds. He foresaw wing loadings up to 80 lb per sq. ft., high aspect ratios of 11, useful-to-gross weight ratios of 50 percent. He said that efficient engines of 3000 hp are already in sight.

Effective July 15, a new clipper service was started through Miami via Jamaica and Colombia, providing new connections with Panagra's schedules. The U. S.-Panama run is now the heaviest-traveled long-range route in the world.

Within the past 8 months, Panagra has added nearly 3000 miles of new routes, displacing or paralleling the air services of the Axis powers. In this connection, the State Department recently revealed that Nazi-controlled commercial air services in Colombia, Ecuador, Peru, and Bolivia either have curtailed or abandoned their runs.

United Air Lines is beginning to cash in on its pilot training course at Seeing School. Major L. S. Jones pins on the wings, as U.A.L.'s flight chief, R. T. Freng, and Col. G. T. Perkins look on.

Report Atlanta Crash

CAB finds that the probable cause of the accident on EAL's Trip 21 near Atlanta last February was "the failure of the captain in charge of the flight to exercise the proper degree of care in not checking his altimeters to determine whether both were correctly set and properly functioning before commencing his landing approach."

The Board also found that a substantial contributing factor was "the absence of an established uniform cockpit procedure on Eastern Air Lines" whereby both captain and pilot check instruments and controls during landing operations.

Details of the findings disclosed that the plane descended to an altitude 39 feet below the elevation of the airport, ran into trees and was demolished 5 miles southeast of the Atlanta radio range station. Considerable power was being applied at the time. The plane, its engines and equipment were all apparently functioning normally "with the possible exception of the altimeters", when the ships contacted the trees, the Board reported.

Export Air Lines Held at Standstill

American Export Airlines' three projects are still held in abeyance. The transatlantic run to Lisbon was held up indefinitely when Congress refused to appropriate money for mail pay on the proposed line. On the company's proposed purchase of British-owned TACA air system in Central America, the examiner has recommended that CAB deny the application, on the ground that the law prohibits airlines owned by another form of transportation (in this case the Export Steamship Company) from acquiring new routes unless the owning agency can use them to public advantage in its own regular operations. On the Export application for a route from New Orleans to the Canal Zone, initial briefs only have been filed. The company has purchased three S-44 flying boats from Sikorsky for delivery this fall, and it still hopes for authorization to use them somewhere.

Newark Back Again

Newark airport, the old eastern trail's-end of the Transcontinental, has been re-opened after a shutdown since last summer. It was the nation's busiest terminal until the opening of La Guardia field in 1939. The four major airlines now operating out of Newark have scheduled 55 traffic movements per day. This is in addition to the 250 movements on La Guardia.

"Biggest In the World!"

The International Airport at Miami, Florida, will be the setting again next winter for the 14th Annual All American Air Maneuvers, scheduled for January 9-10-11. International will be the "largest airport in the world" when present expansion work is completed. At the flying convalcade last winter, 1,355 planes were parked along the then finished runways.

Pilots Want More Pay

For several weeks the pilots of TWA four-engine planes have been negotiating with management for additional pay, on account of the greater responsibility and skill required. At this writing, an arbitration board had been set up.

AIR TRANSPORT INDICATOR

July 1, 1941

127.00

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for June, 1941, to the figure for June 1940. Total for the indicator has slumped slightly from upward trend. For the first six months of 1941 traffic stood at 571,313,202 revenue passenger miles—up 27.1% percent over June 1941.

See Finance page for individual companies traffic figures.

Universal Air Freight

Announcement has been made of Universal Air Freight, Inc., a division of U. S. Freight an organization to provide ground collection and distribution of air cargo. Freight forwarder service has long furnished a great bulk of the less-than-carload merchandise for the rail roads, steamship lines and trucking companies of the United States.

The U. S. Freight Co. uses any and all forms of carriers. In addition to out utilization of rail roads and marine companies, it has over 3600 affiliated trucking companies.

Universal Air Freight does not intend to operate air carriers of its own or apply for a certificate to operate an air freight line. The reasoning for this, they say, is that "our job is to solicit air cargo, deliver it to airplanes and distribute it from airplanes."

TRANSPORT DOINGS

Trans-Canada develops internal air express services in and from New York City. It is trialing four young women as passenger agents, in an experiment to meet war conditions. Heaviest single piece of express carried from Toronto to Dawson City, Yukon, was a transformer 923 lb. Announces addition of round trip between New York and Toronto.

TWA adds Toledo for coast-coast route after opening of Toledo Airport. Inaugurated non-stop service Newark-Chicago. Company recently equips its fleet of 30 Douglas DC-3 Transports with new 1200 hp Wright "Cyclones"—replacing 1100 hp units.

Braniff Airways recently observed fourteenth birthday. CAB hearings held July 7 on application for non-stop Kansas City-Dallas.

United application was heard by CAB July 2 for amendment to consolidate routes 1 and 17 to be known as Route 1. Hearing June 30 on application of United for a certificate Washington-Toledo and application of TWA for certificate Dayton-Washington.

Canadian Airways and Mackenzie Air Service, operating North from Edmonton and Prince Albert to Northwest Territories, announced the consolidation of respective services as United Air Services Ltd.

British Overseas Airways' application to use Baltimore instead of New York as terminal for period of present emergency heard June 23 by CAB.

Continental Hotel Service Corp. of Chicago initiated travel card helping 5000 owners and pilots of aircraft to get hotel accommodations in towns, even though convention packed.

United asks amendment of route No. 11 to include Klamath Falls, Salem and Eugene, Oregon, and route No. 57 to include Bellingham, Washington as intermediate points.

Penn-Central sets new all-time company record for passenger traffic for first six months of 41.

Northwest Airlines got CAB hearing on application for certificate for Chicago and Minneapolis-St. Paul via Milwaukee, Green Bay, Wausau and Eau Claire, Wisconsin July 24.

Recent Awards

War Department

General Motors Corp., Indianapolis, Ind., $2,844,116 for engine parts.
Bendix Aviation Corp., Bendix, N. J., $120,000 for computers and inverters.
Shell Oil Co., Inc., New York City, $1,182,512 for aircraft engine fuel.
General Electric Co., Schenectady, N. Y., $520,000 for regulators.
Glenn L. Martin Co., Baltimore, Md., $459,751 for airplane parts.
Lockheed Aircraft Corp., Burbank, Calif., $62,117,220 for airplanes, engines and parts.
Douglas Aircraft Co., Inc., Santa Monica, Calif., $23,673,700 for airplanes, engines and parts.
Lockheed Aircraft Corp., Burbank, Calif., $30,485,070 for airplanes, engines and parts.
Vega Airplane Co., Burbank, Calif., $26,051,760 for airplanes, engines and parts.
Fairchild Engine & Airplane Corp., Hagerstown, Md., $1,037,543 for airplanes, engines and parts.
Curtiss-Wright Corp., Buffalo, N. Y., $52,567,187 for airplanes, engines and parts.
Douglas Aircraft Co., Inc., Santa Monica, Calif., $21,184,249 for airplanes, engines and parts.
General Motors Corp., Indianapolis, Ind., $41,366,880 for airplanes, engines and parts.
Nash Kelvinator Corp., Detroit, Mich., $15,237,580 for airplanes, engines and parts.
Curtiss-Wright Corp., $292,497,495 for airplanes, engines and parts.
Aro Equipment Corp., Bryan, Ohio, $150,750 for oil hose units.
Bell Aircraft Corp., Buffalo, N. Y., $273,707 for wing armor plate and glass.
Bendix Aviation Corp., Bendix, N. J., $105,247 for maintenance parts.
Wright Aeronautical Corp., Paterson, N. J., $159,460 for crankshaft assemblies.
Walter Kidde & Co., Inc., New York City, $159,102 for oxygen cylinders.
Bendix Aviation Corp., Bendix, N. J., $157,920 for parts for oxygen regulators.
General Motors Corp., Detroit, Mich., $89,075,000 for engines and spare parts.
North American Aviation, Inc., Dallas, Texas, $57,725,572 for airplanes and parts.
Vultee Aircraft, Inc., Downey, Calif., $31,619,280 for airplanes and spare parts.
Northrop Aircraft, Inc., Hawthorne, Calif., $16,287,134 for airplanes and spare parts.
Bell Aircraft Corp., Buffalo, N. Y., $15,885,081 for airplanes and spare parts.
Republic Aviation Corp., Farmingdale, N. Y., $8,165,400 for airplanes and spare parts.
Douglas Aircraft Co., Inc., Santa Monica, Calif., $7,843,010 for airplanes and parts.
Curtiss-Wright Corp., Buffalo, N. Y., $7,809,597 for airplane maintenance parts.
Lockheed Aircraft Corp., Burbank, Calif., $2,797,947 for airplanes and spare parts.
General Motors Corp., Detroit, Mich., $88,000,000 aircraft engines and parts.
General Electric Co., Schenectady, N. Y., $21,776,000 for turbine supercharger assys.
North American Aviation, Inc., Inglewood, Calif., $6,352,658 for airplanes and parts.
Glenn L. Martin Co., Baltimore, Md., $88,418,170 for airplanes and spare parts.
Douglas Aircraft Co., Santa Monica, Calif., $10,597,192 for airplanes and spare parts.
Allison Motors Corp., Syracuse, N. Y., $256,670 for engines.
American La France Foamite Corp., Elmira, N. Y., $108,145 for oxygen cylinder assys.
Wright Aeronautical Corp., Paterson, N. J., $218,382 for engines.
United Aircraft Corp., East Hartford, Conn., $2,7,322 for 3-blade propellers.
United Aircraft Products, Inc., Dayton, Ohio, $595,040 for strut assemblies.
General Motors Corp., Dayton, Ohio, $1,481,083 for propeller assemblies.
Lockheed Aircraft Corp., Burbank, Calif., $777,830 for airplanes and spare parts.
Douglas Aircraft Co., Inc., Santa Monica, Calif., $3,119,435 for airplanes and parts.
Bell Aircraft Corp., Buffalo, N. Y., $7,407,548 for airplanes and parts.
Boeing Airplane Co., Wichita, Kansas, $5,407,794 for airplanes and spare parts.
B G Corporation, New York City, $516,46 for spark plugs.
Sperry Gyroscope Co., Inc., Brooklyn, N. Y., $1,180,680 for flight and turn assys.

Navy Department

None.

By Raymond Hoadley

Military aircraft and accessories received the third largest Congressional defense appropriations in the first year of the armament program ending May 16, 1941, an amount exceeded only by the authorizations for shipbuilding and ordnance equipment groups. Additional funds since authorized or in the legislative mills will assure capacity operations for most of the industry for the next two years. The rate of aircraft deliveries has risen more than 100 percent since last fall and a further doubling of the rate is expected by the end of the year. Thus it would appear that constantly increasing volume should maintain earning power despite lower profit margins and larger taxes. In the meantime the requisitioning of transport planes for the British and the transfer of reserve pilots into active service with Uncle Sam's military forces continues to cloud the near-term outlook for the domestic airlines. However, profits in the current quarter still should show substantial gains over the disappointing returns of the first six months of 1941. Several of the aircraft manufacturing companies probably will declare semi-annual dividends this month as results of operations for the first half of 1941 are tabulated to guide directors concerning the size of the disbursements to shareholders.

Aircraft companies will be hit by higher taxes this year but again, as in 1940, there are a number of companies who should escape the pending increased levies as their 1941 fiscal year does not conform to the December 31 calendar year on which tax changes are based. Aircraft concerns whose fiscal year ends before December include Aviation Corp., Douglas Aircraft, Piper Aircraft and Vultee.

Curtiss-Wright sales and earnings for one month in the second quarter were more than half as large as the $48,000,000 sales and $5,000,000 earnings reported for all of 1939. Deliveries for the first six months of 1941, it is understood, were greater than the $138,720,000 reported for the previous twelve months. The Wright Aeronautical subsidiary, which had total shipments of $67,000,000 in 1940, is estimated to have shipped $75,000,000 worth of engines in the first half of 1941. Current schedules indicate that deliveries for Wright in the second half of the year will be well above $110,000,000.

Sperry Corp. stockholders are looking for a sizable semi-annual dividend this summer in view of the record breaking business the company is doing this year. Sales for 1941 are expected to run $100,000,000 or better while the backlog of unfilled orders is said to have passed the $200,000,000 mark. Still in the negotiation stage are contracts which will carry bookings much higher. At the same time the War Department has guaranteed the company reimbursement up to $40,000,000 for tools and equipment and a big plant expansion program is getting under way.

American Airlines is upping its depreciation rates and to start the revision charged off an extra sum of $65,000 in May to cover the first five months of 1941. The standard five-year depreciation rates will stand for all planes purchased in 1938 or earlier while a four-year rate is being applied to all planes bought since 1939.

The potentialities of air transportation have hardly been scratched, according to an analysis recently published by the brokerage firm of Merrill Lynch, E. A. Pierce & Cassatt. Pointing out that air travel expanded nine-fold in the last decade, the booklet notes that 1940 passenger revenue of the airlines amounted to but 12 percent of that of the railroads while express and freight revenues were only 0.37 percent of the latter's business. Meanwhile market value of the air line stocks totals only 1.53 percent of the value of all the rail securities.

Vultee Aircraft moved into the black, profitwise, in May, coincident with the initial operations of its new mechanized assembly line. Net loss for the six months ended May 31, 1941 is estimated at around $600,000 but it is expected that results for the full fiscal year ended November 30, 1941 will show a net profit. Output by fall is scheduled at about double the May production rate.

Aviation Corp. reported a net profit for the six months ended May 31, 1941 of $862,234, equal to 11 cents a share on the capital stock, as against a loss of $299,825 in the corresponding 1940 period. These earnings exclude the results of operations in several companies in which the corporation has a large interest including Vultee Aircraft, Auburn Central Mfg. Co. and New York Shipbuilding Corp.

Northrop deliveries for the twelve months ended July 1, 1941 were $2,994,913, all but $350,000 of which took place this year. A large portion of the deliveries include a completed Norwegian order for patrol bombers. These planes are now in active service of Norwegian pilots flying with the R.A.F.

Brewster deliveries are now at the rate of $3,000,000 a month and pointed higher as the new Johnsville, Pa. plant is expected to turn out six dive bombers a day by November. Net sales for the first four months of 1941, amounting to $10,608,000, were slightly larger than those for all of 1940. For the same period net profits were $752,277 or $1.46 a capital share, as against $270,195 or 59 cents a share in the first four months of 1940. Successful negotiations for adjustment of prices on certain contracts probably will avoid a loss of $1,394,000 that had been anticipated in the company's 1940 annual report.

Kellett Autogiro had unfilled orders amounting to $2,365,000 on June 30, the highest total in the corporation's history according to R. G. Kellett. A year ago orders stood at $702,000. Sales in the first half of 1941 totaled $532,000, compared with $290,000 in the corresponding 1940 period. Present force of 586 employees will be increased as orders recently received get into production.

Breeze Corp.'s shipments of defense equipment in May, 1941 totaled $1,331,000, a gain of more than one million dollars over the same month last year. The Breeze backlog has climbed from $1,286,000 as of June 1, 1940 to $12,298,000 one year later.

Hayes Mfg. Corporation earned $126,293 for the three months ended May 31, which is a decided increase over any similar period for the past several years, according to Rensselaer W. Clark, president. At the same time unfilled orders increased to $6,614,000, $5,500,000 of which are for aircraft sub-assemblies. Deliveries are scheduled to start on this order in August.

Security transactions in May by aviation company officials and principal stockholders included the purchase of 3,200 shares of Fairchild Aviation Corp. by Ernest Robinson; 3,000 of T.W.A. by Hughes Tool Co.; and 10,000 Western Air Lines by William A. Coultar. Sales included 10,225 shares of Hayes Mfg. Co. by A. W. Porter, Inc.; 3,200 Fairchild Aviation Corp. by S. M. Fairchild; and 1,000 Brewster Aeronautical warrants by James Work.

Industry Backlog

Unfilled defense orders of the aircraft industry increased by approximately one and one-half billion dollars in the past month. They now total upwards of $6,000,000,000 and are well on the way towards a volume that may eventually soar close to the 10-billion-dollar mark! A year ago the industry's backlog stood at $2,145,000,000; $759,000,000 at the end of 1939; and $186,000,000 at the close of 1938. Several important new plants will come into production this fall, raising output well above recent monthly deliveries of around $110,000,000. In addition, a score of other plants, now in the early construction stages, will step up volume late in 1942 to a point in excess of the automobile industry's peak year (1929) of dollar volume. Indicative of the part the motor industry will play in military aircraft in 1942, Ford Motor Company has $440,000,000 in engine and plane orders (including parts for Consolidated Aircraft Company) while General Motors Corporation, through three subsidiaries, has $455,000,000 in aircraft engine contracts. The following table gives the latest approximate backlogs of twenty-seven primary plane and engine producers.

Allison	$242,000,000
Aviation Corp	37,000,000
Beech	61,000,000
Bell	33,000,000
Boeing	300,000,000
Brewster	100,000,000
Buick	124,500,000
Cessna	18,000,000
Chevrolet	85,075,000
Consolidated	600,000,000
Continental Motors	25,000,000
Curtiss Wright	580,000,000
Douglas	600,000,000
Fairchild	20,000,000
Ford	350,000,000
Grumman	68,000,000
Lockheed	270,000,000
Martin	640,000,000
North American	396,000,000
Northrop	47,300,000
Packard	167,000,000
Republic	60,000,000
Ryan	16,000,000
Studebaker	33,000,000
United	350,000,000
Vega	100,351,000
Vultee	158,000,000
	$6,033,420,000

Solar Aircraft reports a net profit of $97,586 for the fiscal year ended April 25, 1941, equal to 20c a share on the 317,776 common shares, as compared with $51,546, or 20c a share on 232,786 shares outstanding in the preceding year.

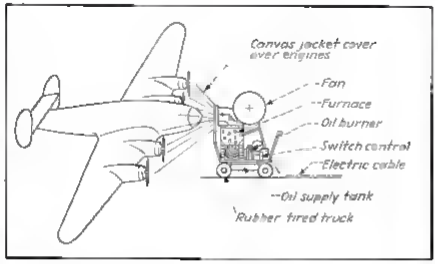
Airlines Credit Corp. a new government agency to finance new airlines and purchase transport equipment for Latin America, is in formation with the aid of several well known Wall Street aviation authorities including W. Barclay Harding of Smith Barney & Co, Wilhom A. M. Burden of National Aviation and Franklin Field of J. E. Swan & Co. Will Clayton of the R.F.C. probably will head it.

Thompson Products established new high record sales volume in the second quarter, exceeding the $8,801,000 previous peak recorded in the March quarter. The expansion program now under way will give the company an annual capacity of around $70,000,000 by the beginning of next year.

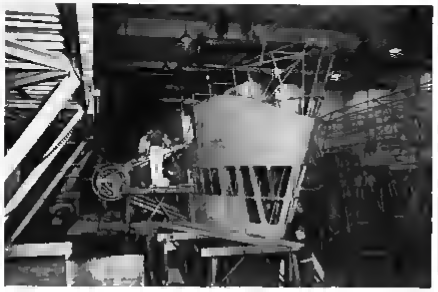
Canada's aircraft production program is being expanded by the award of a contract to National Steel Car Corp. Ltd. to produce Martin B-26 bombers at a cost of $25,000,000. Also it is expected that Canadian Car and Foundry will make the Consolidated four-engine bomber under a contract involving about $30,000,000.

Defense travel is lifting passenger traffic on the domestic airlines to the highest levels in history. Both American Airlines and Pennsylvania Central Airlines—the first to report—had their biggest month in June, carrying 34 percent and 46 percent more passengers that month, respectively, than in June 1940. All the airlines report the largest gains are made in the industrial defense areas.

Here and There . . . *Bell* Aircraft will receive contracts for additional fighters that will raise its backlog considerably above $100,000,000 . . . *Bendix Aviation* will pay a dividend of $1 a share on Sept. 2 to stock of record Aug. 2 . . . Lawrence Ames has resigned as a director of *Lockheed* due to military duties . . . *Wright Aeronautical* plans to raise output at the Patterson plant by 35 percent . . . Right to convert *Consolidated Aircraft* preferred stock into common expires as of Aug. 20 . . . *Grumman* monthly output is equal to the entire annual production for several years prior to the war . . . Lieut. Comdr. J. D. P. Hodapp, U. S. Navy, retired, has been elected a director of *Luscombe Airplane Corp.* . . .



THE NEW AIRPLANE HEATING UNIT for preparing ships for instant take-off. It can be used either for military or commercial ships and should come in at present as a method of keeping airplanes in readiness in the cold climates. Development work was done by the G.M.C. Engineering Co.



A Navy control car made by Goodyear for one of the blimps designed for coastal patrol service. Ship will be 246 ft. long.

The British Are Here

A hand picked group of 550 young Britons—the first of 8,000 British Flying Cadets—have already begun flight training at six primary schools in the Southeast Air Corps Training Center.

Under the direct command of RAF Administrative Officers, the boys will spend 10 weeks in primary training, 20 at Advanced Flying Schools before returning to join the Battle of Britain at home. They are receiving the same courses prescribed for American flying cadets.

They are also receiving plenty of tea for the Training Center is taking special pains to make the youngsters feel at home.

Experimental Radio Station

Federal Communications Commission has approved the application of Air Associates, Inc., Bendix, N. J., for construction permit and license covering a new Class 1 experimental station, using call letters W6XFY.

The new station will be erected at company's plant in California, and is to be used to carry on the program of research and development work in connection with company's projected line of u.h.f. frequency radio equipment and direction finders.

FCC also granted Air Associates license for a Class 1 experimental portable mobile radio station on aircraft, using call letters W10XOF.

Airline Passenger Survey

The airlines, through their regular passenger services, are now one of the main factors in making possible the nation's defense effort, it is indicated in a survey of passengers leaving LaGuardia Field, New York's municipal airport. The survey shows that passengers travelling either as agents of the government or for private companies engaged in defense, constitute roughly 40 percent of all air travellers today. Other transportation would adequately serve almost none of these passengers. Six domestic airlines use the field in 264 scheduled flights daily with 3000 passengers. Of these, 112 persons on flights selected to give comprehensive results, were interviewed.

New York-Washington flights of Eastern and American airlines showed the greatest proportion of defense travellers—more than 80 percent, or nine out of every eleven passengers. In four flights of each line checked, 52 persons said they were on defense business, and 13 were on non-defense business.

One engineer said he now flies 100,000 miles per year, and "could not possibly keep up" with his affairs otherwise.

Transcontinental travel on American, TWA, and United airlines is about one quarter on defense. Of 32 persons interviewed on these flights, 8 were on defense business and 24 on private affairs. Short-haul travel on American, TWA, and Canadian-Colonial divided into almost the same proportions.

Of all persons interviewed, only 21 admitted that they could conduct their business by other means than air travel.

The proportion of persons travelling for the government on eastbound Pan American Atlantic flights (although not included in the survey), checked through newspaper accounts and is roughly 85 percent, while on westbound flights it approximates 40 percent.

Domestic airlines carry hundreds on direct defense business: "ferry" pilots employed by Lockheed, Douglas, Consolidated and other manufacturers turning out warplanes for Britain and the United States, Army and Navy enlisted men and officer personnel.

Correction

In AVIATION Sketch Book of Design Detail, June, 1941, page 82, it was incorrectly stated that the Skymotor illustrated by a drawing weighed 300 lb. This is the shipping weight of the engine; the actual weight of the engine alone being only 178 lb.

In the July, 1941, AVIATION, page 109, it was incorrectly stated that the ferrule attaching machine made by the American Metal Hose Branch of the American Brass Co., Waterbury, Conn., was used on applications for flexible fuel indicator connections, parachute rip cord housing, and air and exhaust connections. The ferrule attaching machine actually is used only on flexible radio shielding conduit.

Seaplane Railway at Boston Airport

Methods for removing seaplanes and flying boats from the water to hangars have been rather primitive to date in most airports. "Bathing Suit Gangs" have attached wheeled "dollies" to the floats of seaplanes or beaching gear to flying boats while they were still afloat. Then the planes have been hauled up a ramp by tractor or other means.

To improve and speed up this operation the Boston Airport installed a "seaplane railway", with tracks and a carriage supporting a flat deck, forming a movable ramp.

This seaplane railway system consists of a cradle, 25 by 25 ft. which runs on a pair of tracks so that the cradle may be lowered into and removed from the water. The design is such that the platform on the top of the cradle is horizontal and at field level when in the uppermost position, while it maintains a slope of 1 to 6 when in the water at any stage of tide. The cradle is operated by an electric hauling machine at a speed of 75 ft. per minute.

To take a seaplane from the water to a hangar, a wheeled dolly is locked onto the floor of the platform of the cradle, which is then lowered into the water until the top of the dolly is just about water level. Then the plane is taxied over until it grounds on the dolly. From here the cradle, dolly and plane are hauled to the upper position in two to three minutes. Subsequently the plane, on the dolly, taxies under its own power to any desired location on the field.

In case it is necessary to remove a plane from the water for a short time only, possibly to examine the floats, the dolly is not required. The cradle itself is lowered until its platform at the inner end, is just above water. The plane is taxied over until the floats ground on the platform. Then the cradle and plane are quickly hauled to the upper position, with the platform horizontal at field level and the plane readily accessible.

This seaplane railway, designed by Crendall Dry Dock Engineers, Inc., Cambridge, Mass., is an adaptation of the larger yacht railways and railway dry docks which they design up to capacities of 5000 tons and more. The installation was made for the Park Department, City of Boston, William T. Long, Commissioner, and John J. Murphy, chief engineer.

All-Dixie Air Show

The Third Annual All-Dixie Air Show, held on July 26 and 27 at Chattanooga was the best attended of the series. National Airplane Trading Day was held on Saturday and scores of planes changed hands. Most of the national manufacturers of light planes were present with late models.

Saturday night Zack Mosley was master of ceremonies at the Aviation Ball which was preceded by the Chattanooga Flyers Club cocktail party. On Sunday thousands of guests attended the air show, where there was a complete line of acrobatic maneuvers and parachute jumping. Carl Gibson was air show chairman.

Salina Breakfast

Aviation breakfasts, one of the midwest's fastest growing sportsmen pilot attractions added to their already wide Kansas popularity June 22 when the Salina Junior Chamber of Commerce championed its second annual Breakfast Flight.

Out in the country where everybody's south forty makes a mighty handy emergency field, flyers from widely scattered points of the state as well as numerous colleagues from Oklahoma and Missouri gathered for a Sunday morning of hangar flying and an interesting prepared program. With civilian pilots and friends as guests the Salina Jaycees entertained at breakfast in the downtown Masonic temple. Both civil and military aviation had their innings. Featured speaker of the program was Capt. Parry B. Griffith, U. S. army air corps adjutant of Marshall Field, Fort Riley.

Capt. Griffith took his audience of more than 225 townspeople and guests on a quick trip through the army air corps cadet training program and complimented the private flying fraternity. "You are doing a fine job in civilian aviation and the government considers it highly important", he congratulated Kansas flyers. Then turning to military flying he quoted a high Washington official "We are building an air force. We will have an air force and it will be ready when the time comes to use it."

Contrasted with Capt. Griffith's report on modern flight training was a brief address by Ed Morgenstern, mayor of Salina and a World War pilot. Mayor Morgenstern reminisced that only 24 years ago they were turning "experienced" military pilots out after eight hours in the air and with eleven hours were learning the art of acrobatics.

Civilian flying was represented by J. H. Wilcox, of Anthony. As president of the Kansas State Aviation Association Mr. Wilcox pointed to the progress of that organization in uniting at least 14 diversified aeronautical groups into one organization in only two years time. Telling of the association's work he described the program now under way to airmark every city and town and nearly all villages in the state. At a board meeting following the breakfast, plans for a huge three or four day air tour were made. The flight odyssey is expected to draw scores of planes on a series of hops covering the entire state.

Following brief appearances by Ed L. Taylor, president of the Oklahoma City, Okla., Aviation club; Jaycee representatives from Kansas City, Mo., and other prominent speakers; Cubs, Taylorcrafts, Luscombes, Culver Cadets, Rearwins, Aeroncas, Porterfields, Fairchilds and other assorted lightplanes took off for home bases amid urgent invitations to return again next year.

Veteran Pilot Airport Manager

Ben M. Towle, 31, a pilot with twelve years experience in flying and nine years experience as a flight instructor, has been named manager of the Fond du Lac, Wisconsin, airport. It was also announced that the east—and—west runway at the airport will be extended 300 feet, for a total length of 2,000 feet.

Academic Tests for Flying Cadets

Announcement is made that educational tests for flying cadet appointments are now less stringent than formerly.

The original regulations provided that any applicant who had not completed two years of college had to pass examinations in the subjects covered in two years of college. This examination was required of all who had not completed two full years of college. No allowance was made for subjects they might have studied in a period of less than two years. Under the new regulations applicants for appointment as Flying Cadets will receive credit for subjects which they have completed successfully in college, regardless of the length of time spent.

According to the new regulations the educational examination will consist of five required subjects and two optional subjects. The required subjects will be English composition and grammar, arithmetic, algebra to include quadratics, plane geometry and plane trigonometry. The two optional subjects will be selected by the applicant from among the following: U. S. history, general history, elementary physics, inorganic chemistry, any modern language except English.

Applicants who show successful college completion of subjects may be excused from examination in such subjects and given credits for a grade of 80 percent in each subject.

The applicant will be required to produce an official document from the college or university he attended showing that he completed the subject as claimed and showing also the grade attained. Such documents will be checked by the examining board to insure that they cover the subject claimed and that the

college is an approved institution

The examination in inorganic chemistry will cover the scope of a standard text book used in an approved high school The examination in modern languages will consist of a brief essay to be selected from a list of general subjects which will be furnished at the time of the examination

TRAINING

Construction is under way on a new $400,000 training center at Lancaster, Calif., to be used by Polaris Academy for training British flying cadets But Victor J. Nelson, contractor is having difficulty with union picketing and has gone to court in an effort to stop picketing of his construction work and interference with his materials delivery service, which he charges By July 15th 100 British cadets were scheduled to arrive to commence their training work under direction of Major C C Moseley, president of the school

Herbert Hartley, president of the American School of Aircraft Instruments, and his chief instructor, William Watkins, were pleasantly surprised recently when the 1941 graduating class presented them with a beautiful plaque inscribed "To Herbert Hartley and William J Watkins and faculty in appreciation for their sincere and unselfish efforts in our behalf The Student Body of 1941—American School of Aircraft Instruments"

Dr. T. G. Phillips, head of C.P.T.P. at Marietta College has joined the Embry-Riddle School of Aviation in Miami as ground school instructor and consultant. Dr Phillips was one of the nine men called to Washington to write the text books for the C.P.T.P. now in use throughout the nation, and he also prepared the Digest of Civil Air Regulations for Pilots Dr. Phillips attended Boston University and the University of Michigan and was formerly on the research staff of the U S Bureau of Standards

C. R Patterson of P & H Aircraft School, Toronto recently set a new world's record in doing 92 successive spins. To do it he pushed his Piper Cub to its absolute ceiling which proved to be 11,800 feet Before starting his spin, he shot off three flares and each time he opened the window to push the pistol outside, he lost 100 feet altitude, indicating the efficiency of the aircraft at that height He noted that he lost 4,700 feet doing the first 40 spins while his motor was running, while the last 52 spins he lost only 4,500 feet The average loss per spin was 100 feet. His only reaction was a strange feeling while pulling out that the machine wasn't recovering properly This was purely an illusion, he states, which again proves the senses cannot be relied on after a series of aerial gyrations.

Instructors Needed

The Air Corps needs instructors for the Technical Schools at Chanute Field, Rantoul, Illinois, Scott Field, Belleville, Illinois, Biloxi, Mississippi, and Wichita Falls, Texas. The Civil Service Commission has announced a nation-wide examination to secure persons for these jobs. Persons who can meet the requirements are urged to file their applications *at once* No written examination is required

There are three grades of positions—Assistant Instructor, $2,600, Junior Instructor, $2,000, and Student Instructor, $1,620 Opportunities for advancement are excellent. Within 30 days after appointment persons may be promoted to a higher grade, up to a maximum of $3,800 a year. For the Assistant and Junior Instructor grades, persons may qualify in the following optional branches: Aircraft Carburetion Systems, Aircraft Engines, Aircraft Hydraulic Systems, Aircraft Instruments, Aircraft Mechanics, Aircraft Propellers, Aircraft Electric Systems, Aircraft Sheet Metal Work, Aircraft Welding, Machinist, Parachutes, Vocational Training, Radio Operating, and Radio Engineering. Assistant and Junior Instructors will teach officers and enlisted men of the Army in the optional subjects indicated

Applicants for the Assistant and Junior Instructor grades must show that they have completed at least 14 units of high-school study Except for certain substitution of college study, applicants must have had at least 4 years of training or experience which gave them both a practical and theoretical knowledge of the particular option in which they are making application, which must have included at least 6 months of instructional or supervisory experience in the particular option. In lieu of this experience, a bachelor's degree in aeronautical engineering from a recognized private or vocational school will be accepted, or for each year of the experience lacking, appropriate college study may be used.

Applicants for the Student Instructor grade must have had either 4 years of prescribed experience in one of the optional branches or specified college work in a vocational trade, engineering applied science, or physics. Student Instructors will pursue prescribed courses of training and upon successful completion of them, may be promoted to Junior Instructors, and later, to a higher grade.

Further information and application forms, may be secured at any first—or second—class post office, from the Civil Service Commission, Washington, D. C., or from any of its branch offices. Applications should be sent to the Secretary U S Civil Service Examiners at Chanute Field.

British Cadets

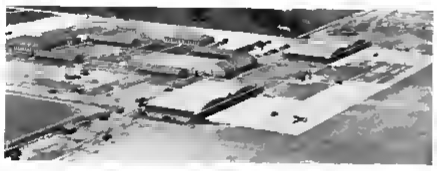
"The British are coming" used to be a familiar phrase The British have arrived again in Camden, S C. after a lapse of 165 years Sixty six youngsters from various cities in the British Isles have been assigned to the Southern Aviation School to be trained by Air Corps for pilots in the R.A.F.

The British fledglings who reported to Southern Aviation School were probably the first in the air of the 556 reporting to the various schools throughout the South-east. After receiving preliminary ground instructions one afternoon. 14 of the class were in the air at 7:10 the next morning.

Allen School

The Allen School of Aeronautics at Hillsgrove, R. I., is now an approved aircraft and engine school Enrollment is now over 200 and the school expects to have 400 students next year With facilities both at 51 Empire St., Providence and at the Hillsgrove airport, the school is well situated to handle both mechanics and flight courses Allen J. Rooke is president

CAA approved school emblem as used by the Alvin Eager School at Gardena Valley airport, Calif. Left, Alvin Eager; right, C. F. Lienssch, C.P.T. supt School uses Interstate Cadets.



VIEW of Pine Bluff School of Aviation at Pine Bluff, Ark Under management of S. D. DeWeese Jr. this school is training flying cadets for the Air Corps

Instead of resigning itself to the slump which many private aircraft mechanic training schools are experiencing as a result of free government training classes, plus the shortage of man-power which is making jobs easy for anyone to obtain, the Aero Industries Technical Institute Los Angeles, recently held an "Open House" night to exhibit its work to the general public A huge crowd jammed the buildings for the fine display that had been arranged and many new enrollments resulted. Aero I.T.I has also placed much greater emphasis on the engineering courses.

Recent Books

AIRCRAFT ENGINES OF THE WORLD By *Paul H Wilkinson*, 256 pages, 123 illustrations, 6 by 9 in Published by Paul H. Wilkinson, New York, New York. 1941 Edition $7.50.

Aircraft Engines of the World is a reference book devoted exclusively to up to-date power plants. Only engines now considered active or under development are included Those that are obsolete or no longer being manufactured are omitted

The introduction of the book describes trends of aircraft engine development in various countries, including Japan and U S S.R The main section contains photographs and complete data of 117 basic engines arranged alphabetically under country of origin. An alphabetical index is included at the end of the book

All of the basic engines in the main section are treated in the same manner. Each engine has a full-page photograph on a left-hand page and complete standardized data on the right hand page facing it. Condensed data of 340 variations of the basic engines are included. English and metric systems of measurement are used for the reader's convenience.

Military engines in production in the U S include the Allison V-1710 E and F models, the Pratt & Whitney R 2800, and the Wright Cyclone 18 (Duplex) Foreign engines also described in complete detail include the British Rolls-Royce Kestrel XXX, Peregrine I and II, and Merlin, the German Hirth HM 515, Junkers Jumo 207 and Mercedes-Benz DB 601, the Italian C.N.A D-4, Isotta Fraschini Beta and Asso L180, and the Japanese Mitsubishi Kinsei 14-cylinder radial

Careful perusal reveals that the information contained in the book is unusually complete. It should prove of great value to all those interested in up-to-date power plants

THE AIRCRAFT YEAR BOOK FOR 1941 Edited by *Howard Mingos* and published by the Aeronautical Chamber of Commerce of America, Inc., New York, N Y 608 pages, $5.00.

As is to be expected, military aviation takes precedence over civil in current interest, and the first four chapters of the new Year Book are accordingly devoted to aircraft activities, production and forces as related to the war

Opening with a short chapter on the war situation, there follows an account of the growth of American aircraft production—the scope of the production program, plant expansions, and outlook as to supply of warplanes. A description of the problems and difficulties which were encountered by the Army and Navy air services is also covered, and these opening chapters give a clear, concise view of the by no means small achievements accomplished by both the industry and the air services in their mutual cooperation toward a common objective.

For those who would like to get away from the war and all its works, a chapter on the airlines of the United States should prove of great interest. Some engaging information is given on the record development of traffic in the air transport system, and additional pleasure may be derived by some in reading astronomical figures which for once are not preceded by the dollar sign This chapter is accompanied by a helpful map made by the CAA of the Federal Airways System Graphs also illustrate the six year progress of air transport, and the growth of air express is treated briefly Headed by Pan American Airways, each of the large airlines, their operations and statistics, is reviewed

A large part of the book is taken over by sections on the aircraft and the aircraft engine manufacturers, with numerous three-views of airplanes and drawings of engines now in production Specifications of both aircraft and engines appear in convenient tables and are followed by a directory of manufacturers

In its twenty-third annual edition, the Year Book presents many interesting and valuable facts which give a good over-all picture of what is going on in aviation

PLASTICS IN INDUSTRY by *"Plastics"* Published by Chemical Publishing Co Inc, Brooklyn, N Y 241 pages, $5.00

"What is the plastics industry and what are the materials it deals with?"

The answer to that question, given in this volume, will clear up considerable misunderstanding in the minds of the general public, and even of the technically trained.

Opening with definitions and descriptions of the several kinds of thermoplastics and thermo-setting resins, the bulk of the book is devoted to industrial applications of the material. Of special interest to aeronautical readers will be the chapter on aircraft construction

Because of the youth of the plastics industry, specifications for plasties are largely lacking, and consequently the aircraft designer is often led through lack of knowledge to specify one kind of material when another would serve the purpose far better This book will be valuable, then, not only for presenting a picture of what plastics can do, but also what it cannot, announcement of which will counteract to some extent the strong doses of sensationalism that have been administered to the public

FAMOUS AMERICAN FLYERS, *by Chelsea Fraser*, 352 pp with index, $2.50 Published by Thomas Y. Crowell Co, New York.

"Pilots Are People" was the title of an editorial in AVIATION, December, 1935 Chelsea Fraser proceeds with this characterization in his book of famous American flyers His biography of the Wright Brothers, Glenn Curtiss, Eddie Rickenbacker, Albert Read, John Rodgers, Richard Byrd, Charles Lindbergh, Amelia Earhart, Frank Hawks Wiley Post, Edwin Musick, Howard Hughes and Douglas Corrigan shows these notables as human, gives a good picture of their background and early strivings, details their achievements, and adds factual data as to the places they later filled. Simply and interestingly told, the book will find a spot on library shelves, and the sketches are very useful for reference. Although in his foreword the author states that these aviators are by no means all the American flyers deserving of inclusion, we were sorry not find Clarence Chamberlin, Lincoln Ellsworth, Ruth Nichols, and Frank Luke, Jr., among them

FIRST BLOOD FOR THE RAF, *by Charles Gardner*, 272 pp., $2.50 Published by David McKay Co, Philadelphia, Pa.

Although the blurb says that "This is the untold story for which the whole world has been waiting," Noel Monks' "Squadrons Up" (AVIATION, March, 1941) covers about the same operations of the Advanced Air Striking Force of the R A.F in France before and during the Battle of Dunkirk. The story of courage against heavy odds bears repetition, but the interesting points of the book are the comments of the author, a reporter for the British Broadcasting Co., the result of his observations and his close contact with pilots He says that when an engine was blown up "glycol fumes were all over the place. The general view was that the glycol was a nuisance."

Gardner is frankly critical of the leaflet raids, the censorship, the absence of coordination between French and British anti aircraft units, the lack of equipment, and states that "Quite a number of correspondents, myself included, had written pieces before the war stressing the need for long range fighters of the Messerschmitt 110 class, but we were officially told 'not to worry'.

I wonder what difference 10 or 15 squadrons of good long range British fighters would have made to the Norwegian story."

FLYING WORK-HORSE!

Fairchild PT-19 Trainers are now logging 1,411 hours a day! Hour after hour, day after day, that fleet of planes takes the roughest of student landings, the strain of aerobatics. They work in dust and mud. Some have been adapted to instrument and night flying.

Wherever they are, in last winter's zero temperatures with the Norwegians in Canada, in this summer's hot sun of the Texas plains, these "flying work-horses" turn in a 1,411-hour day, every day.

Fairchild design and Fairchild construction are once again producing a record in performance and service.

FAIRCHILD AIRCRAFT

Division of Fairchild Engine & Airplane Corporation
Hagerstown, Maryland . . . Cable Address "Faircraft"

1411 HOURS PER DAY

Ranger engines in active service at a score of Army and other training fields are now logging an average of 1,411 hours every day in the week, every week in the year!

Air, under controlled pressure, effectively cools the 6 in-line cylinders of the 175 horsepower Ranger engine in the PT-19 Fairchild Trainer.

Despite the hard pounding of training service, despite the varying climatic conditions from Canada to the Gulf, Ranger has proved its thorough efficiency in this mass test.

One school, operating 191 Rangers, reports an average oil consumption of one pint an hour, gasoline consumption at eight gallons an hour.

With Ranger there can be
no compromise with quality

RANGER
AIRCRAFT ENGINES
FARMINGDALE, LONG ISLAND, NEW YORK
DIV. OF FAIRCHILD ENGINE & AIRPLANE CORP.

Selig Altschul

(Continued from page 115)

vious years' earnings must be adjusted and the basis may thus be established for demanding retroactive restitutions of alleged overpayments of mail compensation

If invoked in the case of American, it is difficult to see how the CAB can avoid instituting investigations of the other air lines in an attempt to recover overpayments of previous years As previously indicated, the air lines are hardly in a position to make any refunds

The examiner also recommends that on and after Jan 1, 1941, a "system" rate of 9 5 cents per scheduled plane mile flown for the first 2,250,000 miles per month flown be established for American This rate is the lowest ever proposed for any air line Moreover this represents the first time a rate has been predicated on a system basis rather than on individual routes

If upheld by the Board, the rate indicated for American would be far below the rate of mail compensation for the other transcontinental air lines United receives compensation ranging from 17 5 cents to 37 cents per plane mile as the base rate of mail pay for its various routes TWA, in September, 1940, received awards ranging from a base rate of 22 cents to 42 cents per plane mile for its separate routes

Obviously, Examiner Law's recommended mail rates for American, if sustained by the Board, will create many disparities in the air mail rate structure of the transcontinental lines and further adjustments would appear to be in order

The air carriers have had ample opportunity to anticipate lower mail pay Throughout its decisions and in its annual reports, the CAA and CAB have reiterated their belief that, as the objective of the air lines in obtaining an economically sound and stable condition is approached, " . . . there will be an accompanying reduction of the dependence of air carriers upon air mail revenue and a progressive decrease in government aid to the carriers in the form of air-mail compensation"

The whole subject of rate-making is of prime importance and recent events would indicate that a permanent plan may be in the offing In the Continental Air Line rate decision, issued May 15, 1941, the CAB not only established certain rates for this carrier, but also advanced two possible methods of rate-making which may set the future pattern in the industry One of these proposals, if adopted, would virtually assure profitable operations to the air lines Until these plans are further developed, it would appear premature to discuss them in detail

Yet to be investigated by the CAB on its own motion are the air mail rates of Eastern, Chicago & Southern and Delta

While mail compensation is becoming less important to the industry, the air lines would all report substantial losses without such assistance Mail pay provides that margin which permits the industry to carry through to net increased revenues resulting from improved passenger traffic Table I shows the relationship between mail revenues and net income for all of the domestic air lines Mail revenues in relation to total revenues range from a low of 17 4 percent for Eastern to a high of 72.2 percent for Inland This table also indicates that the smaller lines may continue to require considerable support in the form of mail compensation in order to maintain satisfactory operations

TABLE I
Relationship of Mail Revenues and Net Income
— Calendar Year—1940 —

	Mail Revenues	*Net Income*	*% of Mail Revenues to Total Revenues*
Eastern	$1,861 000	$1 575 000	17 4%
American	3 913 000	1 869 000	18.9
Penn-Central	585,000	106 000	20.3
United	3,881 000	775 000	24 0
TWA	3 158 000	d232 000	27.3
Braniff	830 000	75 000	32 3
Delta	419 500	d30 700	38.8
Chi. & Southern	403 000	30 000	41 4
Northwest	1 770 000	296 000	48.6
Western Air	808 000	140 000	49 1
Northeast	248 300	d8 800	50 4
National	275 300	44 400	53 1
Mid-Continent	585 200	d60 000	66 9
Continental	435 500	15 200	68.5
Inland	359,500	14 300	72 2

d—Deficit

Nevertheless, the fact remains that the industry as a whole has been receiving less for carrying the mail than it ever did Reduced to a pound-mile basis the air lines received 95 mills per pound-mile during 1940 as contrasted to 1 79 mills for 1934

The diversion of planes to the British in addition to restricting operations of the air lines, is another example of cross purposes in government policy. The commercial air lines are virtually a necessity in maintaining contact with the many and ever-changing ramifications of our rearmament program. Our defense effort may be impeded by the lack of adequate air line facilities. Moreover, the Post Office and the CAB have constantly admonished the air lines to build up their passenger loads With the major lines currently showing the highest load factors in their history, it appears fairly certain that many regular and would be passengers are being turned away Were not so many planes diverted to the British and others, the air carriers could perform a more constructive job in the interests of national defense as well as developing the good will of their public

The air transport industry can face the future with an assurance of long-term revenue expansion New and broader markets in passenger, mail and express operations appear certain Many of the prognostications currently advanced, however, are nothing but tremendous build-ups for a terrific let-down Moreover, the expansion of the industry may take a far different pattern than is generally realized

During aviation's first big boom—in the late 20's—all sorts of predictions were also advanced. For example, in 1929 Anthony Fokker stated that in five years the aircraft industry would be producing 150,000 planes a year More than 10 years have elapsed and the industry is now straining to turn out 30,000 planes a year Were it not for a war, even this production rate would have been far distant

Extensive feeder lines are glibly extended over the entire countryside However, before any new air lines can be started, the CAB must authorize such service. Before any certificates of convenience and necessity will be issued to these so-called feeder routes, it is likely the CAB may have to reverse its present position in order to justify the high government expense attendant with the inauguration of service over these routes An examination of Table I shows the government contribution toward the support of existing feeder lines There are numerous CAB decisions which have denied extensions of existing lines to cities with low density of population because the cost to the government was difficult to justify. Perhaps a new act of Congress would "direct" the CAB to find otherwise.

Commercial aviation has a great potential. The realization of its future markets, however, may take much longer than is popularly supposed

Barron's Stock Averages

	Aircraft	*Air Transport*	*50 Stocks*
July 3 1941	37 00	18 56	71
June 27 1941	36 98	19 47	71
June 20 1941	35 75	19 38	71
June 13 1941	36.18	19 53	70
July 5 1940	33 00	28 03	71

Airports

(Continued from page 85)

would just about meet the present requirements for student training fields Clear approaches were further defined to mean a gliding ratio of 7 to 1 over all obstructions

Up to this time about the only paving was possibly a hangar floor and a small apron in front of the doors Turf was the acceptable surface With the advent of heavier planes it was found more difficult to maintain schedules in wet weather To improve this condition more elaborate drainage systems were designed and laid under the entire landing area, an expensive procedure that did not always work.

However, pilots still preferred turf It offered some resiliency on landing provided a grip for the tail skid thereby acting as a brake, and there being no definite lanes to follow, take-offs and landings could be made in any desired direction.

When a few airports boasted surfaced runways, the question on width was an item of consideration To arrive at something of a conclusion, questionnaires were distributed throughout the industry The results were amazing, suggesting everything between 50 and 1000 feet The latter was thought advisable for formation flying in military service.

Aviation was moving forward slowly but steadily when suddenly it claimed the attention of the entire nation The first non-stop flight between hemispheres had been made. The airplane was acclaimed the coming vehicle of transportation.

But let us go back to the beginning of that flight. There spectators stood tensely watching the overloaded plane slowly lumber along the rain-soaked field scarcely missing the obstructions on the opposite side

A lesson was learned from this observation For later trans-oceanic attempts a short incline was erected down which the plane raced, thereby obtaining flying speed with a much shorter run

For like attempts on the Pacific coast a sward runway was extended to 5000 feet in the prevailing wind direction There were also long sandy beaches pressed into service

It was probably these spectacular flights that were the greatest factors influencing paved runways

Before the year was over, airports were in demand. Good Will flights were in progress and air tours planned Everybody wanted to fly or at least go out and feel of an airplane.

Airport companies were incorporated Elaborate plans were drawn up showing immense administration buildings flanked on either side by innumerable hangars, and runways going in every direction The airport was having its day, but like every boom mistakes were made, potentials were over-estimated and advantages were taken of the over zealous.

In a sense the airport dropped back, but not to the past level It had won its place It had become an essential factor in aviation and its demands were more thoroughly understood Larger areas were necessary, so in 1932 the Aeronautics Branch enlarged the required size to four 3500 feet landing strips and established a transport rating Paved runways were given more consideration, air marking had become standardized and lighting equipment improved Air traffic control was talked about and a bulletin was issued on the report of a committee's investigation

Tests were run in Washington to formulate the effective use of automatic sprinklers employing water in hangar fires The success of these tests has slowly resulted in the installation of sprinkler systems in hangars

Although interest of both science and engineering had been stimulated for airport improvement, it lacked that paramount substance to exist, *money!* Huge sums could easily be devoured in property, grading, drainage, runways and buildings with a meager return It looked like a poor investment It had no appeal The public was not financially interested and with a municipal field the city treasurer could not justify the expenditure of public funds

The airlines were a poor lot from whom to expect any cash support. They held a peculiar position that could not show favoritism They were spending all their money on new equipment Equipment that threatened to make practically every field obsolete.

Here again the airport failed to keep pace with the rapid advancement of aircraft. Faster ships were being rolled out of the factories with heavier wing loadings requiring longer runways, fewer obstructions and flatter approaches Aviation was moving forward while the airport complacently lagged behind

Testing, research, mockups and models long recognized in every other branch of aviation, were ignored in airport design There was a lack of scientific approach and proper coordination of the various branches of engineering involved in the problem including aeronautical engineering There was need for closer cooperation between the aircraft manufacturers and the airport designers.

Expansion could have been made less costly, if the airport engineer had spent a little time at factories examining plans and specifications for the plane of tomorrow Embarrassing situations could have been prevented where hangars were found standing in the middle of the field or some building planted in the approach of the longest runway, after expansion had taken place

There was need, but no authority for authorized assistance Thus the airport just grew—retarded by the want of sufficient funds and political dickering It was a stepchild, a necessary evil that cost too much and took up too much room.

It seemed almost doomed when the Federal Government met the situation and appropriated money for relief, to be used on airport development This money however, was only available to the municipally owned fields Until then the privately owned commercial fields out numbered municipal airports There was a definite transition, as municipalities procured more airports to make these funds available

In connection with this program Congress directed the Civil Aeronautics Authority in the Civil Aeronautics Act of 1939 to "make a field survey of the existing system of airports" and recommend as to whether the Federal Government should participate in the development of a national system of airports and to what extent and manner they should participate.

Under the guidance of the C.A.A and other interested bodies, designs were improved, runways laid and better drainage and lighting installed The face lifting was enormous. Flush type lights outlined the paved strips, drainage was mostly concentrated to the runway area, hangars assumed a brighter appearance and the administration building became an object of attraction Perched on the top stood the control tower—in constant radio communication with planes in the immediate vicinity, guiding them to their destination It seemed a perfect setup far in advance of its predecessors, but was it to stop here?

No! Already the demands are becoming stiffer. Runways intended for instrument landings are to be at least 4500 feet long and 200 feet wide with a clear approach of 40 to 1 Planes are increasing in weight, size and height, necessitating larger hangars and more durable paving Air traffic at some airports is already an unpleasant situation during peak load periods Parallel runways may be the temporary solution

Passenger accommodations although improved, are far from desirable and there is still to be solved that problem of an enclosed loading station or platform for the air traveler's protection

Transport Progress

(*Continued from page 69*)

River in New York, operated 14-passenger twin-engined seaplanes from Key West to Havana; these were converted Navy jobs. Certainly this operation and its luxurious cabin seaplanes was "prophetical of the future," as the 1921 *Aircraft Year Book* so quaintly puts it. Passengers "step from parlor car to parlor flying boat, and an hour and a quarter later are on the quay at Havana," which statement from the *Year Book* might have been taken from a Pan American folder of today. The late Edward Musick of Pan American fame was an Aeromarine pilot.

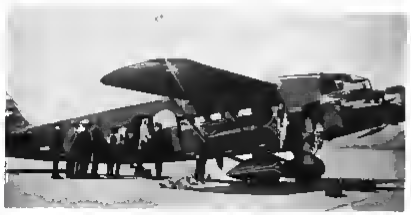
In 1920 Mercury Aviation Company of Los Angeles inaugurated regular passenger service between that city and San Diego. Shortly thereafter, if I am not mistaken, T. Claude Ryan from the other end of the line used Curtiss "Eagle" cabin jobs or Standard J1's converted into cabin jobs; this San Diego-Los Angeles passenger route lasted for about a year.

Mention should be made of Art Smith and his night flying at the San Francisco Panama Pacific International Exposition. This was 25 years ago. He flew every night, when weather permitted, in a pyrotechnic show before thousands of people—a true night flying pioneer. Jack Knight, now of United Airlines, flew the first intentional night mail in 1921 under rather harrowing circumstances.

Reed Chambers' Florida-West Indies Airways was an early pioneer in air transportation. Now, let us look at twelve and a half years ago—the halfway point—that was when private operators had started functioning with mail contracts. Pan American Airways came into being with its service from Miami to Havana. In early 1929 the service was extended to Haiti, Santo Domingo and Puerto Rico. In March the Brownsville-Mexico City and Vera Cruz service started. Then the Canal Zone-Santiago, Chile mail route was established. Western Air Express, operating the 600 miles between Los Angeles and Salt Lake City with Jimmie James and Fred Kelly at the helms of the Liberty-powered Douglases, was in the passenger, mail, and express business at this time. They carried 400 passengers in 1927, ranging from 13 in April to 60 in August according to the 1928 *Aircraft Year Book*, they planned to inaugurate tri-motored Fokker service from Los Angeles to San Francisco in 1928. In 1940 *over* 40,000 passengers were carried over the identical SLC-LA route, with Jimmie James as Vice President, Operations, and Fred Kelly as Chief Pilot. This indicates the steadier employment in air transport than many other industries. Another point in the industry's favor is the lack of seasonal fluctuations in employment of mechanics and others. Passengers in April 1940 over this route were 2,825 and in August, 4,302. In 1927 the fare was $60. It is now $34.75.

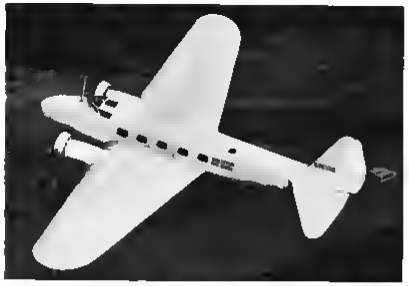
Boeing Air Transport took over the San Francisco-Chicago operation of the air mail service from the Post Office Department on July 1, 1927. They carried 525 passengers during the last half of that year as compared with United Air Lines' approximately 250,000 over the route during the last half of 1940.

Boeing had Seeley Hall, now Vice President of United's Western Division, Oakland, Calif., in its employ from the beginning. W. A. Paterson, President, joined in April 1929. Russ Cunning-



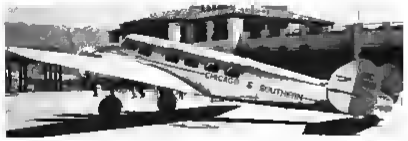
An American Airlines tri-motored Stinson of the 1931-and-later era. This was one step closer to the fast, comfortable commercial transports of today.

America's first sleeper transport, the Curtiss Condor. These are sight-seers, not passengers. Condors were flown over 10 years ago, yet sleepers are still new to many air travelers.



A Boeing 247 in July 1932. This was the first of the fast twin-engine transports.

The great Douglas DC-2 that did so much to revolutionize air travel. These ships were first commercially flown by TWA in 1934.



Sleek, fast, and economical, the Lockheed Electra proved popular on a number of airlines. This model has given way to the larger and faster Lockheed Ladestar

This is a sleeper model of the Douglas DC-3, the most popular air transport in the world. Since 1936 there have been many changes, and this ship too will look out of date in another decade. American Airlines photo

In flying boats there have also been changes. This is an American Airways Sikorsky S-38 flown over the Great Lakes, 1928-1932

Glenn Martin built his Pan American Clippers in 1936 and they brought new luxury and comfort in trans-oceanic flying

bam, now United's Director of Communications, was an early pilot as was Jim Murray who was promoted to be the Boeing Airplane Company's representative in Washington and who is still there. Harold Crary, now UAL Traffic Vice President, came to the company in the early years from the secretaryship of the first air transport association.

National Air Transport, along with B A T's Jack Knight, pioneered in night flying. Walt Addems, now Superintendent of United's Eastern Division, Dick Pfennig, Seeley Hall's vice-presidential counterpart in the east, and Bert Lott were with N A T from the beginning. Eighteen Liberty-Douglases, eight open cockpit Travel Airs, seven Curtiss "Carrier Pigeons," and one trimotored Ford equipped the New York-Chicago run. Whirlwind-powered Travel Airs were used on the Chicago-Kansas City spur. Two-hundred and seventy-five "paid" passengers were carried in 1927 on the two routes; for the successor company in 1940 it was well over 50,000 on the Chicago-New York route alone. Merrill F. Redfern, Executive Secretary of the Air Traffic Conference Division of the Air Transport Association, was one of NAT's first traffic agents. Colonel Paul Henderson was Vice President and General Manager, and Ray Ireland was General Traffic Manager. Reed Landis, now Vice President of American at Chicago, handled publicity and advertising.

Northwest Airways had three of the late Eddie Stinson's Whirlwind-powered "Detroiters" and one Laird in service on the Chicago St. Paul run. Colonel L. H. Brittin, who envisioned service to Seattle and eventually via Alaska to the Orient, was Vice President and General Manager at the time. Croil Hunter, now head of Northwest, joined the company in its early years as traffic manager. George E. Gardner, the current Vice President—Operations, was in charge of airline inspection in Washington. Many of the early pilots, including Mal Freeburg, who was given the first air mail pilot medal, are still with Northwest. One thousand forty-eight passengers were carried on the Chicago-Twin Cities run in 1927, 130,-400 on the system in 1940.

In November 1927, Jack Frye, Paul Richter, and Walt Hamilton (Aero Corporation of California) inaugurated passenger and express service three times a week from Los Angeles to Phoenix, using Fokker Universals and later, it is believed, a Wasp-powered Super Universal. The subsequent histories of these men is well known. Maddux was in the Los Angeles-San Diego service with D. W. "Tommy" Tomlinson, who left the Navy to go with the airline up in the cockpit of one of its two Whirlwind Ford trimotors. A Navy pilot stunted his "scout" into one of these ships which is one good reason why we have Airway Traffic Control *with the recent amendments* today.

"C R" Hugh and Robert J. Smith should, of course, be mentioned as pioneers in American Airways. Few recall that Robert J., now Vice President of Braniff at Dallas, was General Traffic Manager of American Airways in 1932. Clarence Fleming, now of TWA at Washington, was assistant traffic manager. Hainer Hinshaw, now of United, was American's Washington representative. Hugh Smith was one of American's predecessor's first pilots.

Charles Rheinstrom, now Traffic Vice President, was traffic boss of Trans-America, operating across Lake Erie from Cleveland to Detroit. Mark Nevils now of Curtiss-Wright was Director of Publicity. Paul Goldsborough, the only president Aeronautical Radio Inc. has ever had, was a Vice President of Universal Airlines before it and others were merged into American. He negotiated with Captain Eddie Rickenbacker, then with Fokker, for the four-engined F-32, but they didn't accept delivery. Tom Hardin, of course, was prominent in the early Universal Airways picture.

Larry Fritz (TWA Vice President—Operations) was under "Shorty" Schroeder at Ford's and later with the Halliburton Airlines based in Oklahoma City. The Ford airline from Detroit to Lansing, Illinois, under 'Shorty" pioneered radio ranges as they are known today. Eddie Hamilton, the Air Line Pilots Association's Washington representative, was chief pilot on Ford's Detroit-Buffalo freight run.

About this time (1927 and 1928) the Aeronautics Branch was really underway. Charles Stanton, now Deputy Administrator of the C A A, left his post as Operations Manager of the Post Office Air Mail Service to work in the Department of Commerce Airways Division. Clarence Young, Pan American Pacific Division Manager, was director of the Branch and upon William P. MacCracken's resignation to practice law, became Assistant Secretary of Commerce for Aeronautics.

Using the January 1932 *Official Aviation Guide* as a source, we find some familiar names. Lowell Harding (of the C.A.A.) was then Eastern Air Transport's Superintendent of the Northern Division. George Cushing (now Operations Manager of Delta) was the same for the Southern Division. Paul Brattain, Captain Eddie's right-hand man at Eastern today, was Washington representative of the Aeronautical Chamber of Commerce in about 1932 and earlier. "Slim" Carmichael, now Vice President—Operations of PCA, was flying the Lockheed Orions of Continental Airways from Chicago to Washington. His present boss, C. Bedell Monro, was Secretary and Treasurer of Pennsylvania Airlines.

Most everyone in aviation remembers T.A.T. and its air rail set-up; also, the men in it. Colonel Edgar S. Gorrell was one of the first T.A.T. transcontinental passengers. Jack Herlihy of UAL left T.A.T. to go with N.A.T. in 1930. Paul Collins left to help start Ludington ("Every Hour on the Hour"); Luther Harris (now V.P. of PCA) was Superintendent of Maintenance. Jim Eaton, now of American Export, was president of Ludington before it sold out to Eastern. Incidentally, American Export's radio man, Ford Studebaker, was one of the young men who developed the radio range for "Shorty" in the early days of the Ford airline.

Temple Bowen certainly is deserving of mention for his years of successful operation in Texas and Oklahoma, as are T. E. Braniff and his brother Paul.

Alfred Frank and his National Parks Airways later merged with Western Air, under Alvin P. Adam's regime, is another pioneer who "hung on" until the business amounted to something. J. W. Miller, Vice President of Mid-Continent was Secretary of Western Air for many years. "Red" O. M. Moster (American V.P.) was an early pilot and manager of U. S. Airways operating between Denver and Kansas before the air mail contracts were cancelled in 1933. They used Cincinnati-made Flamingo, all-metal, Wasp-powered monoplanes.

Stanley Kennedy, President of Inter-Island is listed in the 1932 Guide as *third* Vice President and General Manager. Juan Trippe, A. A. Priester, and Victor Chenea had expanded Pan American Airways' service, according to the same 1932 guide, to include a circle by way of the West Indies to Buenos Aires and back up the west coast, tying in with Pan American-Grace. Harold R. Harris who flew the world's largest Barling Bomber for the Army four or five years previously, was in charge of operations for Pan American-Grace. He had gone to Peru for crop dusting purposes, being associated with C. E. Woolman, now Vice President and General Manager of Delta, who has always conducted crop dusting activities on the side.

With the cancellation of the mail contracts came somewhat of a shuffle, but with a lot of the same names and faces, particularly the younger ones, turning up. Nineteen thirty-four, when the new contracts were let and the Air Mail Act of that year passed, saw American Airlines (corporate titles changed in 1934) flying Condor sleepers, the brainchildren of Ralph Damon (then with Curtiss-Wright), single engined Vultees, and ten Douglas DC-2's. C. R. Smith came to the fore, Temple Bowen, who did not get a mail contract, went back to the bus business. Central Airlines, which received a contract for the Washington-Detroit route, subsequently, as everyone knows, sold out to Pennsylvania to form Pennsylvania-Central Airlines. Carleton Putnam, Amos Culbert, Bruce Braun (he had been Superintendent of the Stinson plant, and later a Department of Commerce inspector), D. D. Walker and R. L. "Doc" Anderson came into the picture. Previously Carleton Putnam's Pacific Seaboard Airlines had operated between Los Angeles and San Francisco. It moved east and in 1935 the name was changed to Chicago and Southern, which now traverses 903 miles of the Mississippi Valley between New Orleans and Chicago and a spur from Memphis to Houston. C. E. Woolman's Delta Airlines received the Dallas-Charleston contract. In 1934 Eastern Air Lines flew a Douglas transport from Los Angeles to New York with one stop with Captain E. Rickenbacker in charge of the flight. Charlie France, now Vice President of Curtiss-Wright at St. Louis, was Eastern's Vice President in Charge of Operations. Later Captain Rickenbacker, with a passenger in each of the Douglas's fourteen seats made a one day flight from New York to Miami and return over the most important route of its system. Hanford Airlines started between the Twin Cities and Omaha and between Bismarck and Sioux Falls letting out that part of the route from Omaha to Kansas City to Rapid Airlines. Inter-Island received its Hawaiian contract. Long and Harman was successful bidder on the Amarillo to Dallas, Wichita Falls-Fort Worth, and Dallas to Brownsville route, later selling out to Braniff. G. T. Baker won the St. Petersburg-Jacksonville contract. Paul Collins, with Sam Solomon as vice president, won the contract in cooperation with the New England railroads for service in that territory. Alfred Frank's National Parks Airways won the Salt Lake City-Great Falls route, and Northwest Airlines service between Chicago and Seattle. This airline pioneered the operation of the famous Lockheed Electra under the late Fred Whittimore. Jack Frye and Paul Richter came out on top on the TWA transcontinental route and pioneered the Douglas DC-2, as American did the DC-3 later. United Air Lines' Boeing 247's, later improved by more powerful "Wasp" engines and completely streamlined cowlings, operated the west coast-New York route and the Seattle-San Diego contract. Varney Airlines won a contract between Pueblo, Colorado, and El Paso, Texas. This company, now Continental Airlines, under the presidency of Robert Six, still has many of its original employees. Wedell-Williams, the former partner of racer building and racing fame, acquired the contract received by Robertson of St. Louis (Major William Robertson was the operator of an early Chicago Kansas City Airline contract). Wedell-Williams later sold its contract to Eastern. Walter Seller of Wilmington-Catalina Airlines, now Catalina Airlines, never has had a contract nor has he sought one. They have operated successfully for at least fifteen years between the California mainland and Avalon, Catalina Island. Wyoming Air Service, now Inland Airlines, under the management of Dick Leferink and Marvin Landes, started their contract in early 1935, with single-engined Stinson cabin planes. They are now

And on down to today, when we have the Boeing Clippers flying the Atlantic and the Pacific for Pan American Airways.

operating Boeing 247D's exclusively and have a new route from Cheyenne to Huron. Their original contract was from Pueblo to Billings. They sold out the Pueblo-Denver section to Varney and the Denver Cheyenne section a few years later to United. Pan American, as every one knows, extended across the Pacific and then across the Atlantic with great success.

The domestic airlines now have 350 or so modern all-metal airliners. They are running today at approximately 80 percent capacity as an industry average. Average block to block speed is well over 160 miles an hour. Two hundred and twenty key cities are served. Eighty-five percent of the passenger travel is *known* to be on urgent business.

Thus, we have a saga, briefly and sketchily told, of 25 years of air transport progress. Not everyone has been mentioned who deserves it, only a few who came to mind at the end of a busy day of endeavoring to help Colonel Gorrell "block that kick."

Selling Planes

(Continued from page 71)

airplanes looked very hopeful, but was doomed to failure by the start of the European war in 1914.

Curtiss, meanwhile, had developed the JN type tractor biplane as a Trainer for the Army, and taken on Lyman J. Seeley as Sales Manager. Seeley, sensing the possibilities for the sale of airplanes in the war situation, proceeded to Europe. There he met Spencer Grey, the hero of the first British Naval air raid and whose uncle was Lord Grey. It was not long before Seeley had succeeded in securing an almost unlimited order from the British Government for these Trainers. This was possibly the first large scale order placed up to that time.

The following years, through the period of our entry into the war and up to the signing of the Armistice, was a time of production rather than sales, and no one had time to give any thought whatever to private sales. Those owners who already had airplanes hastened to turn them over to such training units as developed at Yale, Harvard, Princeton, and other colleges.

After the signing of the Armistice, what airplane market there was, was faced with the unloading of the huge quantities of war surpluses which had piled up. This was the time of the barnstormer, who covered the country with an ex-Army Jenny which he had picked up at a price which would not much more than cover the cost of the box.

There was such an enormous surplus of Curtiss OX and Liberty engines available at low prices that the next step was to develop new planes to give better performance with these engines. This opened up an opportunity for an attempt to merchandise these new planes against the competition of the much cheaper surplus stock. This effort in several cases achieved quite surprising success and developed an appetite on the part of this limited market for better performance airplanes.

So far, the airplane was a vehicle which could get off the ground and maneuver, but no thought whatever had been given to comfort for pilot or passengers, so that when the early cabin planes were developed they offered an entirely new opportunity for sales. It was not until Fairchild, in search of a better photographic plane, produced the first of his FC series that the pilot was brought indoors.

By the late 20's the country was well into a period of great activity and prosperity, and the aircraft industry with its new and vastly better airplanes entered a time of intense competition for sales, and the first attempts to set up dealer organizations were beginning to be seen. People were finding airplanes of practical value, and always looking for something better, were beginning to bring their old planes back to trade them in on the newest models, which called for dealers with money enough to swing the trade in.

For some time the dealers had been operators of schools and charter services and sales took second place to these activities. The easiest and quickest return was from training and passenger hopping and in addition the operators were pilots, not salesmen. However, with the help and urging of the factory representatives, sales began to grow.

The demand was for ever increasing performance, comfort, and convenience, and the general adoption of the engine starter was almost as important to the sales of airplanes as it was to the automobile.

These improvements cost money, and again following in the footsteps of the automobile, as each airplane got bigger and better it also got more expensive, thereby leaving the potential low-priced field pretty much wide open.

As usually happens, there was someone to step in, and several very good light planes and small engines appeared, and an increasingly consistent drive was made for sales. This field will be interesting to watch after the war.

Again we see more advertising in popular magazines and displays in city show rooms such as were first tried in 1910, and again on the most elaborate scale of all in 1928 and '29. Financing sales became an extremely important part of the business and acted as a tremendous stimulant to aircraft sales much the same way it did with the automobile. In the lower priced field most sales are now financed.

Flying Clubs have had their very important part in the growth of airplane sales all over the world—first the expensive Aviation Country Clubs, and in many countries the government subsidized clubs, but more important in this country, simply the banding together of a group to purchase an airplane.

Several attempts had been made to go into production in order to arrive at quantities which would effect price. There have even been cases of manufacturers arbitrarily selling their product below cost to stimulate sales up to a production quantity. But it would seem that neither the aircraft itself nor the market was quite ready.

Looking back, it is clear that there has been no real continuity of sales effort, and most starts made were based on what was thought to be a safer and easier-to-fly air vehicle, and one depending less on airports.

The first real attempt at safes promotion was the Flying Boat which attempt, unfortunately, was stopped by the World War One. Then we have the post war effort built on the birth of the cabin plane and then the autogiro.

The first really big sales effort to put over an air vehicle was the campaign put on by Pitcairn. The job was well done and much money was spent. There was a lot of enthusiasm and it looked as if the answer had been found, but cost and lack of performance were obstacles too great to overcome.

Some sales effort has been made since on unconventional types, but the biggest job is being done by manufacturers of relatively inexpensive, low-performance, easy-to-fly planes.

Stronger dealer organizations have been developed. Offices and show rooms begin to reflect more accurately the merchandise being offered. The old horse trading methods which prevailed following the post war barnstorming era are over.

In all this, the one consistency is the desire to interest more customers. To interest more customers, we must have more usefulness and less expense. Airports are costly, far apart, and not always where we want to go. Landing strips will help.

New developments in old principles are having wonderful results, and the time may not be far away when we can land and take off almost anywhere and have our own airport in the back lot. What an opportunity that will be for a sales job!

McReynolds

(*Continued from page 81*)

breed who braved a thousand dangers and discomforts to reach that last great frontier of the world, the Pacific Ocean. It is certainly natural that such pioneering people should turn to aviation as the greatest of pioneer industries. For the flying business has demanded greater hardships and has offered greater danger and discomforts for less promise of material gain than any of our great modern industries. So we choose to explain the aeronautical rise of the Pacific Coast as a natural turning of pioneer people to a frontier even greater than that of the Pacific Ocean which had halted their westward progress—the frontier of the illimitable air.

There is ample evidence of early pioneering in aviation along the Pacific Coast. Much as we hate to admit it to our readers, much of this activity took place even longer ago than the year 1916, when AVIATION was founded. Even before Otto Lilienthal, commonly supposed to be the father of gliding, had made his first flights, a California man, John Montgomery, succeeded in flying a glider for a distance of 600 feet from Otay Mesa, near San Diego, Calif. This took place in August of 1883 and has been well authenticated. Montgomery went on to build several gliders and made hundreds of successful flights before he was killed in a glider flight near San Jose in 1911.

San Diego was later the scene of many "Firsts" in aviation history, including the first amphibian plane flights, by Glenn Curtiss, in 1919, first photos from an airplane by Col. H. A. Erickson, in 1911, first "Loop-the-loop" by Lincoln Beachey in 1913, and first ground-to-plane radio contact by Curtiss and Morin in 1912.

Also prior to 1916 were many activities in the Los Angeles area, including the Dominguez air meet held in 1910, one of the first in the world. Glenn L. Martin established one of the world's first aircraft factories in an abandoned church near Santa Ana in 1909.

Strangely enough, when war came no aircraft production resulted in California or along the Pacific Coast, with slight exceptions. Martin moved to Cleveland to undertake volume production of military planes. None of the major aircraft factories now active along the Pacific Coast had then been established. Substantial aircraft engine production was undertaken during 1916-17-18 by the Hall-Scott Co., of Oakland, and a considerable number of training planes were assembled in Sacramento by a company headed by the late Harry Wetzel, who became general manager of the Douglas Aircraft Company. Ed Doak, now president of the Doak Aircraft Company, was with Wetzel in this venture and later came south with Wetzel to join the Douglas company.

Meanwhile, North Island, San Diego, which had been used by Glenn Curtiss as a flying school site during 1911-1914, was selected as a major Army pilot training field. Rockwell Field was established there and became known as the cradle of Army aviation due to the number of successful pilots developed there and the many developments in Army aviation which were initiated. Generals H. H. Arnold and B. K. Young are among today's air leaders who received their early training at Rockwell Field. The Navy was granted use of a portion of the field in September, 1917, and later absorbed the entire island. It became the Navy's biggest single air station.

Even before this development there occurred the initiation in Seattle of aircraft building by W. E. Boeing. Boeing formed the Pacific Aero Products Company in 1916, with E. N. Gott, now vice president of Consolidated Aircraft Corp., as an associate. A year later the name was changed to Boeing Airplane Company. Boeing first built only flying

North American is a relatively new West Coast firm, but it has experienced men behind it, as is evidenced by this sleek bomber, the B-25.

The Ryan B-1—predecessor of the Spirit of St. Louis.

The Douglas company sprang into world prominence with their Around-the-World biplanes, flown by the Air Corps, in 1924. Here one of the ships is being refueled. This flight brought orders to Douglas from both the Army and the Navy.

The Northrop Alpha on floats, developed in 1929 and 1930

Consolidated is an old name in aviation but a newcomer to California. Its growth in the past two years has been tremendous. Chief reason, its 4-engine bombers

boats. Spruce was largely used in the construction of these early planes so Seattle, in the heart of the spruce country, was ideally situated. Before the war was over, Boeing had built fifty flying boats for the U. S. Navy for training purposes. This was followed with an order for twenty-five larger flying boats and then, with the end of the war, there came a long period of comparative inactivity. For a while the Boeing factory was devoted primarily to furniture manufacture, although numerous "odd jobs" of plane building were undertaken, including a batch of DH trainers and ten huge GAX triplane attack ships, heavily armored. In 1921 Boeing obtained a contract to build 200 Army pursuit planes of Thomas-Morse design and soon became the leading American builder of pursuit craft. Concentrating on the pursuit type, Boeing developed the famous PW-9 for the Army, and later the corresponding FB-1 type for the Navy. Several hundreds of these planes, and their later modifications, were built before Boeing turned to other fields.

In 1927 Boeing developed the Model 40-A mailplane, a biplane with accommodations for both mail and passengers, which proved highly successful on the routes of the Boeing System, which later became United Air Lines. The 40-A was followed in 1928 by the 14 passenger Model 80 tri-motor biplane which was used on the main transcontinental airline route.

In 1930 Boeing brought out the revolutionary Monomail, a single-engine low wing cantilever monoplane with retractable landing gear which was the father of the 247 twin-engined transport, as well as of the later super bombers. The Boeing B-9, a twin-engine, all-metal bomber, was introduced in 1931, the 247 twin-engined transport in 1933, and the four-engined Flying Fortress in 1935. Since then Boeing has pioneered in the development of the Model 314 four-engined trans-oceanic 42-ton Clippers and the Model 307 Stratoliner which was the first high altitude commercial transport.

Although W. E. Boeing retired from all connection with the Boeing company in 1934, the organization has continued to expand under the leadership of C. L. Egtvedt, Chairman, and P. G. Johnson, president. Under the needs of our present national defense program the Boeing organization has expanded many times, and now operates three plants in Seattle, one in Vancouver, B. C., and the subsidiary company, Stearman Aircraft, in Wichita, Kansas. In Seattle alone there are now more than 12,000 employees at work in factory space totaling 2,344,500 sq. ft., and further expansions are in progress.

While the great Boeing organization was developing in the northwest Donald Douglas, then chief engineer for Glenn Martin, in Cleveland, was growing restless and in 1921 he left Martin to form his own company. Although the Douglas Aircraft Company later became the largest independent airplane manufacturer in the country, Donald Douglas had a difficult time getting started in Southern California. He was first backed by David Davis, who is now well known as the developer of the Davis wing, and started operations in a room behind a barber shop in Hollywood. Soon Douglas won Army recognition and established the Douglas Aircraft Company in Santa Monica. The meteoric rise which followed came largely as a result of the Army around-the-world flight, made with Douglas airplanes. These planes proved themselves so well designed and well built that the young company was soon swamped with business both for the Army and Navy. Like a rolling snowball, the Douglas organization has never stopped growing and now has more than 30,000 people at work in its three huge Southern California factories. Douglas has served as a training school for many of the leading engineers and executives who have gone on out to build up other aviation enterprises in the Pacific Coast area. Also, the Douglas company has fostered the development of aviation supply depots and accessory manufacturers in Southern California, thereby greatly stimulating the growth of aircraft manufacturing in this area.

We should digress momentarily to comment that another reason for the remarkable growth of the aviation industry in the far west has been the unusual spirit of cooperation and initiative among all the various aircraft firms. By mutual helpfulness they have aided in the establishment of many important aviation enterprises and activities. Among these may be listed the Society of Aeronautical Weight Engineers, the Aircraft Manufacturers Service Association, Aircraft Parts Manufacturers Association, etc.

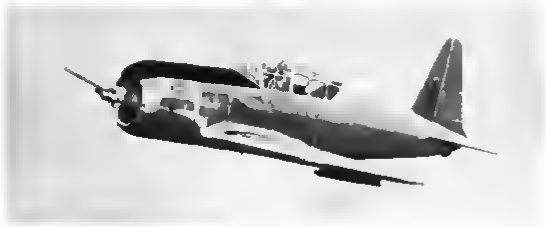
Following the success of Douglas biplanes used for the around-the-world flight, Douglas developed and manufactured many military types and, until 1934, built no commercial planes except for a fleet of special mail-passenger biplanes used by Western Air Express in starting the pioneer Los Angeles-Salt Lake City airline in 1926; a single experimental monoplane developed with an eye to the private market, and the famous Douglas Dolphin amphibian, a twin-engined monoplane. A number of these Dolphins are still in active airline service on the Catalina Island ferry service and in the Coast Guard.

But in 1934 the Douglas DC-2 made its bow in commercial service and since that time Douglas has never been able to catch up with the backlog of orders. The DC-2 quickly became the standard transport plane over most of the world's air routes and has been followed by

the equally successful DC-3. Douglas has developed many military planes of the most modern type, of which the DB-7 is now the most widely known. Douglas also pioneered in development of large passenger plane equipment with the DC-4, which is now in limited production pending military developments. Latest Douglas triumph is the 82-ton B-19 8,000 hp. Army bomber, largest military plane ever built, which was test flown successfully on June 27th by Major Stanley Umstead.

While the aeronautical pendulum was swinging down the Pacific Coast from Boeing to Douglas, it continued on down to San Diego and ran smack into Claude Ryan, who, in 1921, was flying on the forest patrol after graduating from Army Cadet training with no war to go to. Starting a flying service in San Diego, Claude Ryan soon perceived a need for airline operation between San Diego and Los Angeles. He rebuilt a number of Standard biplanes, equipping them with cabins for this operation and claims to have operated the first regularly scheduled inter-city passenger airline in the country. Soon there came a need for mail planes to operate on the difficult Pacific Air Transport route between San Diego and Seattle and, in 1926, Ryan designed and built the M-1 high wing monoplane which was adopted for this service. From the M-1 was developed the Ryan "Brougham" type passenger monoplane which later enjoyed wide popularity. More important was construction of Lindbergh's plane, which started from San Diego on its history-making New York-Paris hop. The Ryan Company moved from San Diego to St. Louis and eventually evaporated in the mists of the great 1929 disappearing act. But Claude Ryan stayed right in San Diego operating his flying school. Perceiving a need for a modern trainer, Ryan developed the S-T in 1934 and this type has since been adopted as a standard primary trainer for the U. S. Army Air Corps. Hundreds of the S-T type have been built for the U. S. and various foreign governments, and for private owners and operators. The Ryan Aeronautical Company now employs more than 1800 people and has a backlog of over $15,000,000.

Even before Donald Douglas came to California to organize an aircraft company, Allan Loughead and his brother Malcolm were busy developing a new plane. Their first venture was in Santa Barbara, and consisted of a biplane flying boat. Then they came to Hollywood and, with the help of two young engineers, John K. Northrop and Gerard Vultee, built the first Lockheed Vega. This plane was so far ahead of its time that its success was almost instantaneous. Record flights by Lockheed Vegas became so numerous that the slogan, "It takes a Lockheed to beat a Lockheed" became proverbial. Lindbergh, Wiley Post, Amelia Earhart, Sir Hubert Wilkins, Frank Hawks, Art Goebel and many other famous pilots chose Lockheeds for record flights of the 1928-34 era. But again the depression years eventually caught up with a struggling young company, and the Lockheed organization fell apart. Robert E. Gross stepped into this picture in 1934 and formed the present Lockheed Aircraft Corporation. With the help of Carl Squier, Lloyd Stearman, Cyril Chappelet, Hall Hibbard, and others, Gross soon introduced the Electra, all-metal twin engine transport. Like the earlier Vega, this plane was an immediate success and orders poured in for the Electra and later for its companion models the 12 and the 14. Advent of the European war swamped the young Lockheed organization with the largest single order given any American company in 1938, a British order for $33,000,000 worth of Lockheed Hudson bombers. Hundreds of these brilliant planes have now been built and delivered. Now Lockheed is in production on the P-38, or Lightning, called the world's fastest interceptor, and is starting work on the new Constellation transport, a four-engine plane designed by Howard Hughes which will be bigger and faster than any commercial plane yet built in this country. Lockheed has also developed a large subsidiary firm, the Vega Airplane Company, which will build an improved version of the Hudson bomber to be known as the Ventura.



The Vultee Vanguard in flight

Lockheed also has another "baby" through its interest in the Menasco Manufacturing Company, builder of Menasco aircraft engines. This firm is an outgrowth of the Menasco Motors, organized back in 1929 by Al Menasco. Menasco developed the first American inverted type in-line air-cooled aircraft engine. Menasco engines won many laurels in air racing during the 1933-39 period and are now widely used for primary training work.

Another training plane engine builder in the Southern California area is Kinner Motors Inc. This firm pioneered the small radial engine. Originally organized by W. B. Kinner, the company has gone through a number of re-organizations and is now very active in the manufacture of engines in the 125-150 hp. class.

Four recent additions to the California aircraft industry are the Consolidated Aircraft Corporation, San Diego, North American Aviation, Inglewood, Northrop Aircraft Inc., Hawthorne, and Vultee Aircraft, Inc., Downey.

Consolidated is the fabulous child of Major Reuben Fleet's initiative. With a 17-year history of successful aircraft design and manufacture, Consolidated did not come to San Diego until 1935, involving a major transfer of plant equipment and personnel. The growth since then has been meteoric. Consolidated PBY patrol boats, both two and four-engined have established astonishing records for performance and reliability. Hundreds of them have been built. And now Consolidated is completing factory facilities which will provide more than 75 acres of factory floor space in the San Diego area alone. Much of Consolidated's production capacity is now being concentrated on the new B-24 four-engine bomber.

North American Aviation is also a newcomer to Southern California, although J. H. Kindelberger, president, is an old resident, having served for nine years as chief engineer of the Douglas Aircraft Company.

In 1934 Kindelberger was elected president of General Aviation Manufacturing Corporation, of Baltimore. In 1935 the name was changed to North American Aviation, a subsidiary of the General Motors Corp., and late in 1935 production of the first North American basic trainers was started in the new factory at Inglewood, Calif. Since that time more than 3500 of these B-T

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the establishment of an aeronautical research unit. The plan was to reopen Langley's old laboratory in the Smithsonian. A committee made a study, reported favorably. On May 23, 1913, a distinguished group was named as an advisory committee for the proposed laboratory. It included Captain W. I. Chambers, Glenn Curtiss, Orville Wright, Dr. Walcott, and officers from the Army and the Navy. But the effort was short-lived. The committee held only three meetings when the Comptroller of the Treasury cracked down. He ruled that the committee not having been established by law,—government funds and personnel could not be used for its work. That was that, so the Advisory Committee of the Langley Aerodynamical Laboratory simply shut up shop.

But Dr. Walcott was not to be stymied by mere absence of legislation. A few months later he approached the President with a new plan,—to establish by law an advisory committee for aeronautics. Meanwhile, however, war had broken out in Europe. The President, then engaged in "keeping us out of war", considered the formation of the committee a "warlike gesture' and withheld his approval. But again Dr. Walcott refused to be stopped. Groups of interested aeronautical people met frequently at his house to discuss plans, outline strategy. After a pick and shovel session on Capitol Hill, he succeeded in getting a rider attached to the Naval Appropriations Bill. It provided for the establishment of an Advisory Committee for Aeronautics to consist of 12 members appointed by the President, serving without compensation. In a charitable mood, Congress set aside the munificent sum of "$5,000 per year for five years, or so much thereof as may be necessary" for the work of the new committee. (NACA's appropriation for Fiscal 1942 is close to the $15,000,000 mark).

The Bill became law on March 3, 1915. Thereafter events moved swiftly. On April 2 the President appointed the first National Advisory Committee for Aeronautics. Brigadier General George P. Scriven was first chairman, Naval Constructor H. C. Richardson, first secretary. Its members were Professor J. S. Ames, Captain Mark S. Bristol U.S.N., Professor W. F. Durand, Professor J. F. Hayford, Professor Charles F. Marvin, The Honorable Byron P. Newton, Professor Michael I. Pupin, Lieutenant Colonel Samuel Reber U.S.A., Dr. S. W. Stratton, Dr. Charles D. Walcott.

At this point a now familiar face came into the picture. There was an ambitious young fellow working his way around Washington as court reporter, secretary to an Admiral, and proprietor of a shorthand school, who found enough idle time on his hands to act as clerk to the Advisory Committee's first secretary. He transcribed the minutes of the first meeting. It was for that job that the first voucher was made out against the Committee's $5 000 appropriation,—payment of $26 67 on account of clerical services to one John F. Victory. A permanent appointment soon followed. John Victory, now secretary of NACA, became the Committee's first employee, the oldest in point of service in the present organization.

The first meeting was held April 23 in the office of Secretary of War Garrison in the old State, War and Navy Building. The group settled down to consider the "large amount of important work to be done." First and foremost, airplanes were needed, and a flying field on which to base them. Plans were discussed for securing some means or other for the conduct of "full-sized experiments." Here was the original statement of a policy that still holds,—to conduct as much research as possible at full scale. (The NACA was the first aeronautical organization in the world to operate a full scale wind tunnel. It is now designing a new full scale tunnel for the Ames Laboratory at Moffett Field that will dwarf any now in existence.)

For its first Washington headquarters, the NACA moved in with the Signal Corps of the Army in the State, War and Navy Building. Lieutenant Colonel Samuel Reber with two civilian employees constituted the Signal Corps staff for aviation at that time. The Navy's interests were represented by Captain Mark L. Bristol as Director of Naval Aeronautics. He was assisted by one clerk. Interesting to note that during the spring of 1916, when Colonel Reber was incapacitated by an accident, and before Lieutenant Colonel Squier, his replacement, could be recalled from his job as military attache in London, a certain Captain William (later General "Billy") Mitchell was acting in charge of the aviation section of the Signal Corps, and for a period was in close touch with NACA affairs.

The importance of the new Committee's work was soon given tangible recognition. Within a few months the appropriations had been boosted to $85,000, and the Committee began to get its teeth into "important work." A research program was laid down which sounds quite familiar even today. It was proposed to study, (a) stability of aircraft by mathematical investigation, (b) improvement of air speed meters for the prevention of stall (c) more efficient wing sections (d) efficient and economical motors "to rival the best automobile engines in the United States and the best aeronautical engines abroad," (e) propellers, (f) form of airplane,—"toward natural inherent stability," (g) radio telegraphy,—a problem with which NACA does not concern itself today, and (h) "other physical problems," including studies of non-corrosive materials, of flat and cambered elements for control surfaces, and the generation of hydrogen (also not part of today's program).

As an indication of the state of the aeronautical art as of the time the NACA came into being here is an excerpt from a letter from Admiral D. W. Taylor, Chief of the Bureau of Construction and Repair of the Navy Department, to the industry and the Committee, specifying the kind of airplanes the Navy wanted without further ado:

"Speed range 50 to 95 miles per hour with full load consisting of one man (160 lbs.), 2½ hours' fuel and oil a radio set weighing 50 lbs. and usual instruments consisting of tachometer, air speed indicator, altimeter, and inclinometer. The radio set will be supplied by the Government, and in the design its weight may be assumed located at the center of gravity. The span shall not exceed 28 feet. A structural factor of safety of 6 shall be provided."

Such requirements seem modest enough now. Then, they challenged the best efforts of the airplane designers.

Right from the start it was recognized that if the newly formed Advisory Committee were to be of maximum value to the Army and the Navy, it must have the full cooperation of the airplane manufacturers and designers. That problem came up at once due to the urgent need in 1916 for development of a reliable airplane engine. Obviously, nothing could be done to develop a satisfactory airplane program without satisfactory power plants. The 90 hp. Curtiss OX and Hall Scott engines of that period did not measure up to requirements, but they were the best that America had produced. Bigger and better engines were needed, and at once. The Advisory Committee decided to call together a conference of representatives of the industry to discuss this vital matter. A public session of the Executive Committee was held in the Smithsonian Institution on June 8, 1916. It brought together for the first time many of the leaders in the aviation industry. The slogan of that meeting was expressed by Captain Bristol of the Navy,—"We want an engine!"

At first, the opinions of the Services and of the industry over what consti-

tuted a good engine seemed to be widely divergent, but gradually, as that day wore on, something like consensus began to emerge. Industry and Government, with their feet under the same table, finally began to carve out a joint specification that was mutually acceptable. That meeting started a chain of events that, within a year, led to the birth of the Liberty engine.

That meeting also set a precedent. It was the first of many between NACA and industry. It was the forerunner of the annual Engineering Conferences held at Langley Field since 1926,—sessions that have been most fruitful in the advancement of civil and military aeronautics in the United States.

The Committee was also charged with the production of research reports, the creation of a standard aeronautical nomenclature, and the establishment and upkeep of an aeronautical bibliography. So, it went into the publishing business, too,—about the same time Lester Gardner published his first issue of AVIATION. With neither laboratories nor technical staff of its own however, it had to draw upon the work of other agencies. Its first volume of seven technical reports included papers by men at the Bureau of Standards, and by such commercial concerns as John A. Roebling's Sons Company, Goodyear Tire and Rubber, and U. S. Rubber. A few universities were represented. In fact, Technical Report Number One came from the Massachusetts Institute of Technology, authored by J. C. Hunsaker and E. B. Wilson. In its first 2½ years of existence, the Committee published 23 Technical Reports.

It was to the universities that the Committee first looked for help. During the summer of 1915 an extensive survey of facilities, activities and interest by educational institutions in aeronautical research had been made. The report concluded that "... The interest in the colleges is more one of curiosity than of considering the problem as a true engineering one, requiring the development of engineering resources and is therefore not yet of sufficient importance to engage their serious attention." There were a few exceptions. Dr. J. C. Hunsaker of M.I.T. had gone abroad in the summer of 1914 and had brought back with him designs and specifications for a wind tunnel based on the N.P.L. pattern. At Stanford University considerable progress was being made in propeller design under the direction of Dr. W. F. Durand. Elsewhere, little was in evidence that made much sense. The Guggenheim Funds that were established later to encourage aeronautical research in U. S. universities, were still ten years in the future.

Although the tunnel at the Navy Yard was put to good use, the research needs of 1916 and 1917 far and away outran the facilities. The Committee presently came to the conclusion that it would have to go into the research business itself if it were to exercise properly its function of keeping the military services informed on the latest developments.

NACA's $85,000 appropriation for its second year had included funds for "a movable combination field office, machine shop, dynamometer shed, hangar, and power plant, including a dynamometer carriage and truck." It was first proposed that this heterogeneous collection of equipment should be set up on Hains Point in Washington, although at that time the spot was pretty much of a swamp. But a farsighted Commissioner of Parks put his foot down. The Point was to serve other ends. Today, what might have been NACA's workshop is a public golf course.

Dr. Walcott then went into a huddle with the Secretaries of War and Navy and after some intensive investigation the tract now known as Langley Field, near Hampton, Virginia, was selected for an Army and Navy experimental field and proving ground for aircraft. The NACA was to have space on this new field.

Scarcely had the site been selected when the Committee began to move in. Construction of an administration building (the first permanent structure on Langley Field) began early in 1917. A young engineer from the Curtiss Company named John H. DeKlyn went down to supervise construction. He left the Committee in February 1920 and is now with the Aluminum Company of America.

Concurrent with the establishment of a research station went the equally important task of selecting people to man it and to supervise it. Trained aeronautical engineers were scarce, trained research men scarcer. Committee Clerk John Victory went scouting for talent. In the course of his travels he visited Massachusetts Institute of Technology. There Professor Edwin B. Wilson, of the Mathematics Department, called his attention to a brilliant young graduate student named Warner who was working with the wind tunnel and had already done outstanding work in aeronautics. Victory reported his find to Dr. Ames. Shortly negotiations were under way, and on January 29, 1919, Edward Warner became Chief Physicist of the NACA. When he moved to Langley Field late in March of that same year to become the head of the aerodynamics research he took with him from the Institute his associate, Frederick H. Norton, who later succeeded him. Warner's brilliant contributions to the early work of the NACA both in design of wind tunnels and in flight research, are too well known to need recounting here. He and the motor scooter, on which he used to dash back and forth between administration building and flight research hangar, have become an integral part of NACA legend.

When Ed Warner left Langley Field in the late spring of 1920, he spent several months in Europe as NACA's representative. The Committee had early recognized the need for keeping in touch with European developments. Dr. Durand had resigned the chairmanship in 1917 to go to Paris as Scientific Attaché to the American Embassy. To carry on the work he started there, a Paris office was set up in 1919 with William Knight in charge. Warner's trip in 1920 helped fill in the gap between Knight's resignation and the appointment of J. J. Ide as NACA's resident European representative in April 1921.

Engine research facilities were early provided at the Langley Field laboratories. Leigh M. Griffith had come East from California in 1917 to take charge. He left the Committee in December 1925. Marsden Ware, now with Packard joined NACA in June, 1918. He went to Langley in Feb. 1919, to work in the power plants div. He was there until he resigned in 1927.

Growing laboratories and growing responsibilities called for constantly enlarging office personnel both in Washington and at Langley. Several members of the staff at NACA headquarters today can look back with pride over nearly a quarter of a century of service. Miss M. M. Muller, Chief of Intelligence; Miss Ruth Scott, Chief of Finance; Miss Catherine Wheelsr, Chief of Correspondence, and E. H. Chamberlin, Assistant Secretary, all came into the organization well before 1920.

To most people in U. S. aviation today the names NACA and Dr. George W. Lewis are almost synonymous. For more than 20 years Dr. Lewis, now Director of Aeronautical Research, has been NACA's common denominator. His interest in aeronautics antedated by many years his connection with the Committee. It began when he was a student at Cornell and persisted after his graduation in 1908, during which time he was a teacher and a consulting engineer. In 1917 he became associated with the Clarke Thomson research group in Philadelphia. This outfit had over $200,000 available for research in aviation and had specialized in research on aviation engines. In 1917 George Lewis came to Washington to offer the facilities of the Clark Thompson laboratories to the Government. The newly formed Power Plants Committee of the NACA turned over to him the

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problem of the development of a 2-stroke cycle engine. The first of his reports to the Committee deals with the poppet valves. This work brought him into close association with the Committee and in 1919 he was invited to cast his lot with the new organization. He came on board November 6, 1919, as Executive Officer and immediately took active charge of the construction and organization of the laboratories at Langley Field, a job that he has pursued tirelessly and efficiently from that day to this. He was appointed Director of Aeronautical Research July 1, 1924. He has seen aeronautical research grow from a stepchild of one national emergency into the *sine qua non* of another. He has always kept before him the thought that he himself expressed on the occasion of the dedication of the Wright Brothers Memorial wind tunnel at M.I.T. in September 1938, "Of all the engineering sciences, aeronautics is unique in this respect, that it is more critically dependent than any other upon the proper conduct of experimental research and upon the availability of correct scientific information as a basis for engineering design."

Condors and Humming Birds

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planes have been rolled out of the Inglewood plant, and numerous other planes have been developed there, including the new North American B-25 medium bomber, and the new "Mustang" pursuit. There are now more than 12,000 employees in the million-sq.ft. plant at Inglewood, and additional factories have been established at Dallas and Kansas City.

After helping develop the Lockheed Vega, John K. Northrop formed a new company to promote development of multi-cellular aircraft structures, using smooth dural sheet material. Out of this development came the Northrop Alpha and Beta models, developed and manufactured in Burbank as a subsidiary of the Boeing Airplane Company. Northrop later joined the Douglas Aircraft Company and developed the well-known Gamma and Delta models and the Northrop attack plane, all of which were manufactured in the Inglewood factory now operated by Douglas as its El Segundo division. Leaving the Douglas Company, Jack Northrop joined with La Motte T. Cohu to form the new Northrop Aircraft, Inc., in 1939. A factory was completed in Feb. 1940. Since that time the factory has in little more than a year been expanded four-fold, and the number of employees has increased from 109 to 2500.

This is Mac Deeds left, new aviation chief inspector for Vega, and Woody Deeds vice president in charge of production for Deck aircraft, as they were in 1918 with a successful glider they built and flew.

Another recent development in Southern California is Vultee Aircraft, Inc. Originally developed by E. L. Cord for manufacture of the Vultee V-1A transport designed by Jerry Vultee, this company has been re-organized since Vultee's death and is now an independent unit of the Aviation Manufacturing Corp. Vultee operates three factories in Downey, Calif., Nashville, Tennessee, and Wayne, Mich. Production is divided among army observation planes, attack bombers, basic trainers, and pursuits. The company also produces the Stinson 105 commercial and private owner plane. Under the leadership of Richard Millar, president, a group of young executives has been gathered into the Vultee organization with the result that expansion has been very rapid and this company is now one of the major manufacturing units of the entire country.

It would take many more pages than are available in this entire issue of AVIATION to do justice to the entire aviation industry of the Pacific Coast. Many important organizations have not been mentioned. Among these are the many parts and accessories firms now so active in connection with the national defense program. But we must conclude this article with the hope that the case histories included in it will serve to remind our readers that there is something special going on in aviation out on the Pacific Coast. Whether this is a sort of Shangri-La for birds, both feathered and man-made, or whether a happy combination of pioneering people and a world crisis has resulted in the astonishing developments briefly reviewed, it must be concluded that never in the history of any industry has there been such a spectacular and spontaneous expression of man's inventive and productive genius as in the 25-year record of aviation progress along the Pacific Coast.

25 Years of Aviation

(Continued from page 49)

Board, contributed an article to the first issue of AVIATION and later became Technical Editor. In 1935 he assumed entire editorial charge of the magazine.

During my ownership of AVIATION, I had two business associates. One was William D. Moffat, whose long publishing experience contributed much to the practical problems to be met in a new venture. Later Earl D. Osborn joined me in the company, succeeded me as publisher and in 1928 transferred the property to the McGraw-Hill Publishing Company.

AVIATION started as a semi-monthly publication. Its full title was, "Aviation and Aeronautical Engineering." To cover the great volume of news that resulted from the World War, we started AIRCRAFT JOURNAL as an aviation news weekly. This was continued until after the War, when it was merged with AVIATION and the combination was published as a weekly until the depression in 1930, when AVIATION became a monthly.

It is seldom that a periodical of any type has a continuous editorial policy for a quarter of a century through many changes in editorial direction. The editorial I wrote for the first issue and which set the course which AVIATION was to follow from the start has turned out to be almost prophetic in stating the underlying principles that have brought AVIATION world wide recognition as a reliable, accurate and informative aeronautical publication.

Naturally, it is a great satisfaction to its founder to join in the celebration of the twenty-fifth anniversary of AVIATION and to express the hope that under the able direction of the great McGraw-Hill publishing organization it may continue to excel in those qualities of trustworthiness that have characterized its distinguished career of service to world aeronautics.

Lester D. Gardner

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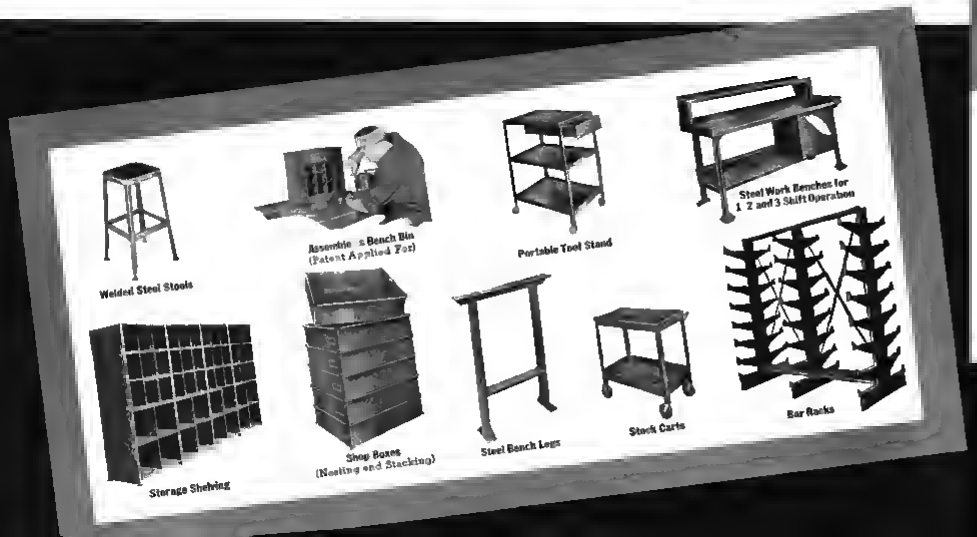

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Aircraft Instruments

(*Continued from page 91*)

to the speed of their turning A pointer suitably geared to the collar will indicate r p m.'s on a properly marked scale

3 The chronometric type where a time-keeper, in the form of a clock escapement, checked revolutions made in one second intervals and rang them up as it were on the indicator pointer The pointer always registers the latest count If the count was greater than the one before, the pointer got a boost up scale by the amount of the difference and it less the pointer dropped down scale by that amount The National Cash Register Co, quite appropriately, built one form of this instrument by the thousand about a year or two after the time of which we write.

Today, forms of 1 and 2 are in use but with synchronous electric drive instead of the flexible shaft in all but the simplest installations There is also an all electric Air Corps type where a special generator driven by the engine feeds an electric indicator marked in r p m.'s

Oil pressure gages connected to the power plant also have an early date

To close this section, the following of today's engine instruments may be mentioned manifold pressure gage, cylinder temperature gage, exhaust gas analyzer or fuel-air ratio indicator, and gas flow meter gage

In the flight instrument group, the magnetic compass comes first in the early days of cross-country flying and it still holds first place today By name we recall the Creagh Osborne as one of the first in 1916 developed for aircraft work It was a generous sized bowl liquid compass with a flat card, no gimbal suspension, but instead arranged to nest in a bed of horse hair in an outer shell It could be placed on the floor of the cockpit or with an inverted figured and lettered card, a 45 degree reflector would give the proper mirror image at eye level This was soon followed by several models of Sperry design in which the bowl was exchanged for a cylindrical glass shell with a glass top giving full visibility to the sensitive element

The 1916 pilot learned by experience that the function of a magnetic compass was merely to indicate the magnetic meridian while in straight flight

The question of height was answered by the aneroid barometer, graduated in feet to measure height by atmospheric pressure or the weight of the atmosphere above the point of observation These early instruments had no temperature compensation and were not sensitive

The answer to wind drift was frequently only wide painted lines on the lower wings of biplanes at 5, 10 and 15 degree angles to the side of the fuselage by which crobbing angles of flight with respect to the ground could be judged The Sperry Gyroscope Co produced about this time a drift meter called a Synchronized Drift Set, consisting of a low-power telescope with a parallel line grid in the field which could be turned through an angle when looking down over the side of the fusetage to line it up with the ground track Simultaneously, the angle was transmitted to the compass rubber line by means of a Bowden wire control At a later date these Drift Sets were used on the Atlantic flight of the N C boats

Air speed has been measured in several different ways In the days of the open cockpit, the mechanical type was much in use, such as the Morell cup anemometer of the meteorological station and a deflecting plate type with a pointer to indicate deflection in terms of m p h The type that brought its indication to the instrument board and has held its place there is the differential pressure operated instrument At one time a venturi tube was used in the air stream for the differential pressure head Today the Pitot-static head is in universal use. In the indicating instrument the important element is a dia-

A Liberty powered DH converted for the air mail, in early 1920's. Note that the ball bank is below and separate from the turn indicator The MPH instrument, center is one of the early air speed indicators

The instrument panel of a modern pursuit plane Courtesy of Curtiss-Wright

phragm. At first light rubber or rubberized fabric was used instead of the thin corrugated metal diaphragm box of today.

We were not long in wanting some of our answers in terms of *rate*. The first question of this kind had to do with rate of climb or vertical speed up or down. The Custer balloon statoscope with a stop watch gave this information. (See illustration on page 90.)

The principle of its operation was the change in volume when rising or falling of a quantity of air contained in an insulated chamber. This chamber connected with a curved glass vial at one end by means of a capillary tube. The vial at its other end had a similar opening to the atmosphere. The "breathing" of this chamber through the vial would equalize the internal with the external atmospheric pressures when disturbed by changes in altitude. This breathing was visualized by the breaking and reforming of a globule of oil trapped in the vial. When it took place at the atmospheric end, rising was indicated and the frequency was the rate, vice versa, at the inner end, descending was indicated.

The redesign of this instrument for airplane use gave us our *first* aircraft *rate instrument*, known as rate of climb, or vertical velocity meter, reading directly in feet per minute.

Here we may introduce the *second* aircraft *rate* instrument to be invented —a gyroscopic one, the Sperry Turn Indicator. The need for this instrument was not so much in answer to the question of how fast am I turning as to how well am I holding to a straight course. The early flyer was guided only by landmarks and the uncertain indication of a compass swinging disconcertingly in response to acceleration forces acting on the heavy end of the magnetic needle. The turn indicator

Pilots' cockpit of an American Airlines DC-3 with the scores of instruments used in air transport planes. In center of panel is Sperry automatic pilot and in center foreground is the Sperry R.C.A. automatic direction finder.

consists of a small air-driven gyro operated by a venturi tube. Its axis of rotation is athwart ship. Its gimbal or precession axis is fore and aft. A light spring restraint about this axis maintains a zero indication in straight flight but any right or left deviation of the airplane causes a corresponding tilt to take place about the gimbal axis and the amplitude of this tilt is proportional to the rate of turn. The early instrument had a shutter type dial that exposed large or small white areas to the right or left when indicating.

The instrument now has a blunt pointer indicator whose width is a measure of the deflection required for a standard rate of turn and in addition it is fitted with a ball level vial which indicates the proper bank in a turn by remaining at the center. It is among the essential flight instruments today and as such has contributed to many history-making flights.

The gyroscope was first applied to the airplane in the form known as the "Sperry Stabilizer" as shown in the accompanying picture of a Curtiss F Boat. The gyroscopic unit shown in the foreground, made up of two pairs of electrically driven gyros provided an artificial horizon reference from which electrical signals were taken to control the power take off from the windmill servomotor, seen in the background under the radiator, to the airplane controls.

In a historic sense the "Sperry Stabilizer" back in 1916 and earlier was a gyroscopic flight instrument. It had degree scales on it by which lateral and longitudinal angles of flight attitude could be checked, but unfortunately it frequently had to be installed in locations where these scales could not be seen by the pilot, and its Flight Instrument function was therefore subordinated to its "Stabilizer" function.

It was not until ten years later that post-war commercial aviation took an upward turn. The Daniel Guggenheim Fund for the Promotion of Aeronautics was formed and contributed much to this end. One of its most important activities was the establishment of a Full Flight Laboratory under Lieutenant James H. Doolittle for the study of what was then called fog flying, now called blind or instrument flying.

It was not until 1929 that Jimmie Doolittle's call for gyroscopic help came. Sperry engineers brushed the dust off of some museum pieces and set to work rebuilding them for his work, and on September 24, 1929, his historic blind flight and landing was accomplished entirely by instruments. Thus was born the Horizon and Directional Gyros of today.

Not all instruments with a bright beginning have stood the test of time. Two years before the date above, Charles A. Lindbergh made his historic Atlantic flight. A new compass, the earth inductor, was credited in a large measure for his successful navigation to the Irish coast. The earth inductor compass had been preceded by one or more types of distant-reading compasses, the object being to locate the compass proper in a more favorable position away from disturbing magnetic conditions usually found at the instrument panel. The earth inductor compass was what is called a zero reader. It used the current developed by a coil of wire rotating in the earth's magnetic field, the current thus induced being a function of the orientation of the commutating brushes with respect to the earth. With this type of compass, one set in the desired course by hand on a dial which through a long flexible drive shaft set the angle at the compass proper, and then "on course" indication was shown at a zero center reading galvanometer.

A number of factors contributed to its final disuse, chief of which was the laying out of airways by beacon and radio beam, and two-way radio phone communication. The azimuth gyro checked with a modern air compass for a standby is the approved flight combination today.

There is some sign of a reawakened interest in remote reading compasses for military purposes, but this is more likely to lead to newer developments rather than the revival of old ones.

Auxiliary instruments for the airplane started from scratch at the time we write about, and the list has been changed or added to from year to year. Space will not permit us to more than catalog them. The early instrument manufacturer had the problem to find the necessary extra power for those instruments like the Automatic Pilot that required it. The engine builder provided no extra power take-offs at that time. On the other hand, the airplane designer had not begun to "clean up" his plane designs and therefore did not mind a power windmill or propeller driven generator or two fastened to the side of the fuselage and for the vacuum operated instruments a good-sized venturi tube in the slip stream was accepted practice.

This picture has rapidly changed in the last few years for all ships in the high speed, and large multi-motored classes. Auxiliary power demands have been met by small gasoline engine driven generators in many instances. The engine manufacturer now makes special provision for driving vacuum and hydraulic oil pumps as well as generators of increased output.

Electrical indicating systems today

(Turn to page 234)

Materials

(Continued from page 86)

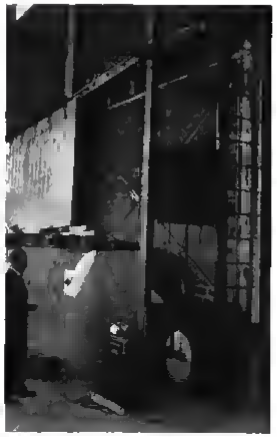
lac, varnish or dope when required, such tests should comprise alternately soaking in salt water and drying, etc.

Specifications for military airplanes issued today refer to Bulletin No. 23 which is a list of approximately 825 specifications for materials and processes which is published monthly in order to keep the industry informed of new and revised specifications.

It is interesting to note the emphasis placed on resistance to vibration at this early date, even if the "crystallization" would not be accepted by metallurgists as a cause of breakdown in fatigue. The stresses induced by reversals of load and vibration produce the majority of failures of aircraft and engine parts, but the basic fatigue strengths of the materials, which are now well established, are not considered as important as the faults in design or fabrication which introduce stress concentration factors.

Service in Mexico and Texas had also made the engineer conscious of the necessity for adequate protection of the structural members of airplanes and propellers. Research in this field has been continuous. The linseed oil, iron oxide metal primer which took from twelve to sixteen hours to dry has been replaced by a zinc chromate primer with a quick drying synthetic resin vehicle. This primer has given excellent service as a corrosion inhibiting covering. The original tung oil, natural gum varnishes and enamels, used exclusively for many years for wood finishes, have been replaced by coatings manufactured from synthetic resins of the formaldehyde and alkyd types. The goal for exterior protective coatings has been a one-coat finish, pigmented to give the color scheme desired, which would dry in from thirty to sixty minutes to a hard adherent film of sufficient flexibility to avoid cracking on flat vibrating surfaces. This has been achieved in some of the latest camouflage finishes.

Glue joints in the early airplanes were made with a hot, hide glue or cold, liquid glue, both susceptible to absorption of moisture and delectable to fungi. Blood albumin glues for plywood and casein for wood assemblies were introduced in 1917 and immediately became widely used on account of their superior moisture resistance. The latter is still used extensively for assembling parts at the airplane factories, although cold setting urea formaldehyde glues of equal strength and moisture resistance and practically free from fungus attack, are coming into use and undoubtedly, will gradually replace the casein. Phenol formaldehyde glues, often applied in the form of thin films, produce the water-resistant plywood required by Army-Navy Specifications. A thermoplastic glue of the aceto-butyrate type, used as a cement for laminated glass, has been used for joining layers of wood veneer, but is not the equal in creep resistance at high temperatures to the thermo setting types.



Early apparatus for measuring impact load on oleo landing gear strut and tire

The desire to conserve metal for use in highly stressed parts of combat airplanes has acted as a stimulus for the development of substitutes which may be used in training airplanes and parts such as doors, floors, flaps, seats and brackets, and which may be divided into several classifications.

(1) Plywood manufactured in sheets on standard platen presses and used flat or formed by steaming and bending and later glued to the structure of the airframe.

(2) Plywood manufactured by wrapping successive layers of veneers in strips or sheets around a form of the desired shape and molded in place.

(a) Using casein glue at room temperature and simply applying pressure—now practically obsolete.

(b) Using a thermoplastic or a low-pressure urea formaldehyde thermosetting glue and flexible die which will follow the contour of the molded shape. The whole assembly is placed in an autoclave and set under regulated low pressure and temperature.

(c) Using a phenol formaldehyde thermosetting glue with male and female dies which will withstand high pressure and temperatures.

(3) Plastics reinforced with wood, fabric or paper, by thorough impregnation and cementation, followed by the application of heat and pressure. The fillers are generally laminated although a macerated fabric is also used. Depending upon the relative stiffness of the filler, the material can be made into intricate parts by cementing preformed pieces in a mold.

(4) Plastics molded to the desired shape in a die from molding powder and fillers.

Plywood was used extensively in the form of flat sheets screwed to wooden trusses for fuselage construction prior to the advent of the welded steel, fabric-covered fuselage which was first produced in this country in 1919. The paneled fuselage was heavy and the maintenance cost was high due to deterioration at the attachments from mold and vibration. Formed sheets for leading edges and complete wing covering have been more satisfactory although separation of the plies and mold growth was frequent until the modern glues came into use. The monocoque fuselage was quite successful in some of the early transports and is finding a field in training airplanes. Interest in the fabrication of parts such as doors, instrument boards, cowling and control surfaces, from plywood and plastics, has received a marked impetus in the past year. The plastics have the advantage of greater resistance to moisture absorption.

A Fokker tri-motor used for a flying laboratory.

A plywood may absorb from four to thirty percent by weight, of moisture, depending upon the efficacy of the protective surface film. Plastics generally absorb less than one percent. The design values for plywood have been established for average samples by laboratory test and usage and no improvement is possible except by selection which restricts the supply. Plastics have been highly publicized as the panacea for all the strategic, economic, and engineering problems of the aviation industry, generally by individuals with either a vague knowledge of plastics, of airplane design, or both. It is essential that structural materials have balanced properties under all the conditions encountered in service. Complete data are necessary on the tensile and compressive stress-strain characteristics, and the shear, creep and fatigue strengths under operating conditions, before a material can be used in engineering designs. These data must be obtained on representative samples which, in the case of molded parts, may involve considerable study. The extremes of operating conditions for aircraft have been established as −65 degrees Fahrenheit and +160 degrees Fahrenheit, and 100 percent humidity. The following values are desired:

*Specific Tensile Strength	22,000 lb./sq. in.
*Specific Yield Strength	13,000 lb./sq. in.
*Specific Flexural Strength	22,000 lb./sq. in.
*Specific Modulus of Elasticity	3.6 × 10⁶
Fatigue Limit	30% of Tensile Strength.
Impact Resistance	5 ft. lb.
Creep	Equal to magnesium alloys on temperature range of −65°F. to +160°F.
Hardness	Resistant to surface abrasion.
Durability	The material shall show no softening, swelling, blistering or other defects when submerged in water, gasoline or oil. It shall not check, crack, warp or change shape when exposed to sea-tropical atmospheric conditions for a period of one year.

Note (*) Strengths divided by specific gravity

The improvement in light transmission and durability of transparent plastics has been especially noteworthy so that it is extensively used as a replacement for laminated glass. Celluloid, with a life expectancy of about two months in Florida, has been replaced by acrylates which show no loss in light transmission after six months. The surface hardness is not equal to glass, but progress is being made in improving this condition.

In the first World War the supply of linen was suddenly curtailed. It became imperative to use a domestic fiber for airplane fabric. Using sound technical methods, a cotton fabric was produced which has been used for the past twenty years with only slight modifications in finish.

The Government also found it necessary to establish plants for manufacturing cellulose acetate since the pyroxylin (cellulose-nitrate) dopes were too inflammable. Clear dopes were pigmented to improve durability. The acetate proved to be inferior to the nitrate dope in maintaining fabric tautness at high humidities and was replaced at a later date by a pigmented nitrate dope containing a slow burning pigment. The latest development is a dope which contains such high solid content that it must be applied hot in order to reduce the viscosity sufficiently for spray application.

Another later development which was initiated in order to obtain a substitute for the strategic material, rubber, resulted in the production of several synthetic compounds which have characteristics superior to the natural product and have become necessities where resistance to petroleum base fluids, elevated temperatures, and weathering, is essential. The modern airplane is equipped with hose, fuel cells, vibration dampeners, deicers, and packings of various types fabricated from neoprene, buna, or thiokol.

The upholstering of airplanes has also undergone a complete change from the original natural leather cushions stuffed with hair. Artificial pyroxylin leathers, which were a distinct fire hazard, were followed by the non-aesthetic and stiff, painted fabrics, in turn replaced by fire-resistant rubber-base artificial leather and rubber sponge.

There are some materials which have not changed. A chrome-vanadium, S.A.E. 6130, was used for a few aircraft fittings in 1916, and today, for the Curtiss welded steel propeller blades. It is significant that the original specifications stated that "it should be melted in a Heroult electric furnace to be free from dirt." The steel manufacturer today subscribes to this same idea when he melts aircraft quality steel to pass magnaflux inspection. The majority of the fittings were 0.25 carbon steel until the higher speeds and greater load factors required the substitution of an alloy steel with higher mechanical properties. The chrome molybdenum steel X-4130, first used by the Army Air Corps for the fabrication of welded tubular steel fuselages, has also become the standard composition for sheet and bars and is used by practically every country in the world, on account of the absence of the strategic element, nickel, its relatively low cost, weldability, and ability to harden in air to a moderately high tensile strength with a high tensile-yield ratio and good ductility, and also over a wide range of tensile strengths when quenched and drawn. For applications over approximately ⅜ inch in thickness, a higher carbon chrome-molybdenum steel, 4140, has come into use, or with the addition of nickel, X-4340. A steel which can be air quenched to a tensile strength of 150,000 pounds per square inch, instead of 90,000 pounds per square inch, may replace the X-4130 for some applications. The only steel which has been used for the complete airplane structure and covering is one containing 18 percent chromium and 8 percent nickel. This steel can be cold worked by rolling or drawing so that the strength-weight ratio is comparable to the low density alloys of aluminum and magnesium. It can be easily formed and spot or seam welded without appreciable loss in strength or corrosion resistance. Considering these advantages, a wider application may be anticipated as more design data become available. The serviceability of the material has been established since several amphibians with stainless steel wing structures have operated successfully over a period of years. It is now generally used for firewalls and accessories requiring a hard, wear resistant surface. This steel in the annealed condition, with titanium or columbium as a stabilizing agent, has practically superseded the low carbon steels originally used for exhaust stacks and manifolds. Inconel, an alloy containing 80 percent nickel, has superior heat and corrosion resistance, but its uses may be curtailed due to the desire to conserve nickel.

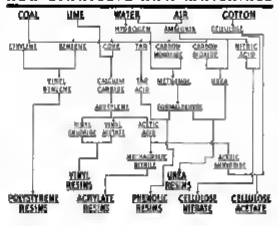
There were no heat-treated aluminum alloys used in production airplanes in this country in the first World War, although the Aluminum Company of America had produced duralumin sheet with the following properties: (Bureau of Standards Report, February 12, 1917)

Sheet 0.034 inch in thickness:

Average Tensile Strength	55,000 lb./sq. in.
Proportional Limit	24,580 lb./sq. in.
Elongation in 2 inches percent	14

This alloy, which is now called 17S, was replaced for general use by an alloy with about one percent more magnesium which developed tensile properties

PLASTICS FROM NON-STRATEGIC RAW MATERIALS



Materials

(*Continued from page 200*)

about 15 percent higher. The discovery of inter-granular corrosion in the wing covering of foreign airplanes operating in this country, led to the development in 1927 of a pure aluminum-coated duralumin by E. A. Dix, which solved the problem. Several other aluminum alloys, cast and wrought, have been developed for special applications.

It is of interest to note that the first tests on thin sheet for wing covering were made in 1919 on material 0.008 inch in thickness and the engineer concluded that since the weight was three times that of doped fabric and the tear resistance no greater, its use as a wing covering was doubtful. This illustrates the analysis which is often made when a new material is introduced. It is not used to the greatest advantage until a school of design has been established which caters to the individual characteristics of the new material.

Magnesium alloys of lower density than the aluminum alloys, but showing little advantage in strength-weight ratio except in the form of castings, were introduced about 1928. The wrought alloys are not as easily formed into cowling and structural shapes as the aluminum alloys, and the corrosion resistance is less, which has retarded their application to airframes. The castings are used extensively in engines and represent from two to three percent of the total weight of the airplane.

The enormous expansion in facilities to produce aluminum and magnesium will undoubtedly have an effect on the applications of these metals after the emergency. Since the large production will foster lower prices, it is probable that they will maintain their present dominance in the aviation industry.

During the first World War the need for conserving and expanding the resources for materials used in aircraft construction was as acute as it is now. The principal structural material was spruce. Fortunately, the trees were available, but it took a large organization of men and equipment to cut and dry the timber, and a reduction in specifications for the allowable angle of grain and number of defects in finished parts was necessary in order to conserve it. The supply of hardwood for propellers, and ash for longerons was extended by splicing and laminating the smaller pieces of timber. Metal propellers of forged aluminum alloy, solid steel, and welded steel have eliminated the spectre of a shortage of hardwoods. It is interesting to note that a

(*Turn to page 216*)

Gliding

(Continued from page 95)

Duration has become less and less popular with contestants. The American record set by Lieut. William Cockes, Jr. in Hawaii, of 21 hours and 34 minutes, still stands.

While records at national and sectional contests have created interest, the actual progress of motorless flight has been achieved by the activities of the clubs throughout the country. Now numbering 158, they deserve particular mention and credit for the interest they have created and maintained in gliding and soaring.

No history of gliding would be complete without mention of the late Warren E. Eaton, whose enthusiasm for motorless flight did so much to advance it. Warren Eaton, who had a distinguished career as a flyer in the World War, was one of the pioneers in the American gliding renaissance. A participant in the early contests, a director of the former National Glider Association, a founder of the Soaring Society of America and its first president, he was the driving force that carried the movement forward.

It is difficult to appraise the most important factors in the development of motorless flight during this 25 year span. Had not J. C. Penny, Jr., and Edward S. Evans become interested, Warren Eaton might never have gone into the movement with all of his enthusiasm and ability. The three men, each in his own way, have made substantial contributions. Under the leadership of Eaton and the Soaring Society of America, gliding achieved its greatest forward step.

Much credit, too, is due to such men as R. E. Franklin for the development with his brother, Wally, of the famous Franklin utility glider. The designs of Hawley Bowlus of California in his ships, Augustas Hallar of Pittsburgh, the Schweizer brothers of Elmira with their excellent two place job—the efforts, work and enthusiasm of Commander Ralph S. Barnaby, Richard DuPont, Lewin Barringer, Jack O'Meara, Stanley Smith, Parker Leonard, John Robinson, Chester Decker, Stanley Corcoran, Emil Lehecka, Arthur B. Schultz, Harland Ross, Rob Auburn, Harvey Stephens, Udo Fischer, H. L. McHenry, Floyd Sweet, Youston Sekella, and many others. Special mention should be made of Earl Southee, who has long been affiliated with the national group. Such a list could be extended but it is not personal history we write but the brief history of a movement, and one that is far, far older than the 25 years encompassed in this article.

Fred Lemke

Glider being towed at Elmira by a winch tow. This method has replaced the old-fashioned shock-cord launching.

The names of Elmira, N. Y., Arvin, Calif., Frankfort, Mich., Lockport, Ill., Ellenville, N. Y., and Wichita Falls, Tex., have all made their mark in the recent history of motorless flight.

Design has greatly improved. The somewhat frail and crude craft of 1926 have been smoothed out, built up in performance and appearance until, like the power ships of the same period, they are better and far finer in performance. To even the untutored eye of the layman a picture of the ships in the first national contest and a similar group in the national contest just concluded show a striking development in appearance.

The records of performance of these gliders and sailplanes as has been mentioned will prove the point.

From the single place, primary gliders where not so much as a fuselage protected the pilot, the machines have been improved until such a large carrying glider as the Gross F5 with a capacity of 4 passengers appeared and flew successfully.

Mention should be made of the changes in launching technique. First of course, came the shock cord. The use of airplanes and the use of automobiles have remained constant. The most efficient device and most popular is the power winch mounted on a truck chassis.

Looking ahead, it is to be hoped that a national program for glider training can be inaugurated and placed in competent hands. It may well be part of the present pilot training program of the C.A.B. and reach in particular the age group between 14 and 18. Such a program is not an expensive project.

The continued interest of the Army and Navy in glider development will be invaluable.

Much speculation exists on the potential commercial value of gliding. No one can yet determine or forecast accurately what this will be. American genius given the opportunity may open new fields for motorless flight.

We must acknowledge that the carefully planned program of the Germans and Russians carried them a long way. America can go farther faster once we adopt a sensible program.

Here is the challenge to the Soaring Society of America to prove its value as a truly national organization. What it accomplishes in leadership from now on will be of great importance to the further development of American motorless flight.

Literary Associates

Glider students at Lewis School of Aeronautics, Lockport, Ill. are getting real flight instruction while flying six feet off the ground. These four wind machines, powered with Ford 85 hp. engines that drive 7 ft. propellers, send a 45 m.p.h. wind against the glider. Wind machines were invented by Comm. E. F. McDonald, President of Zenith Radio, who is a gliding enthusiast.

The automatic radio direction finder under test. William P. Wiggins senior radio mechanic observes the dial on the unit is rotated in a barber's chair mount. The signal generator and the antenna overhead provides the signal to which the unit responds

A. A. Radio

(Continued from page 118)

"You need two chairs to start a business." The chair worked perfectly after suitable changes were made in the top to accommodate the instruments under test. It became desirable to have a second test position and when Charles Banks, American Airlines radio engineer, went to get another barber's chair, the dealer asked, "What did I tell you?"

Buffalos at Singapore

(Continued from page 106)

pilots with less than 100 hours of flying time.

Features contributing to the Buffalo's high speed are the efficient tapering of the wing, clean cantilever design of the tail structure, flush riveting, and complete enclosure of all devices that it is possible to keep within fair aerodynamic lines. Stable stall characteristics of the wing are accomplished without the aid of special stall prevention devices. Landings and stalls may be made without any tendency for one wing to drop. Stall action is a gradual settling of the nose without dropping off at either side. According to R.A.F. fighter pilots, the Buffalo is "a delight to handle," and "can turn on a cent."

Quick assembly is aided by the method of packing. Each ship is packed in two cases, one of which contains engine-mounted fuselage, landing gear and parts, and the other containing the wing with propeller and tail surfaces.

Specifications and performance data available for publication on the Wright Cyclone powered Brewster Buffalo are:

Span	35 ft
Length	25 ft. 8 in.
Height	12 ft. 1 in.
Wing area	209 sq ft
Gross weight	6,520 lb
Maximum speed (at 16,600 ft.)	345 m.p.h.
Rate of climb (S.L.)	4000 ft./min
Service ceiling	34,000 ft
Cruising endurance	10 hr 40 min

Loening

(*Continued from page 63*)

time been patient enough to work out details such as dynamically balanced control parts to eliminate the flutter.

On the other side of the picture many a plane with little military value was for years used in a most popular way in the Army and Navy because the upholstry and windshield were well-worked out and because a lucky combination of slipstream and wing flow—totally unforeseen by the designer—gave unusually good control on landing that made it easy for the pilot.

A further lesson to learn on looking over these years has its humorous aspects. When we read—for example—Specification 100 A of the Navy which was the bible for the construction of Navy aircraft from 1919 to 1923, we find that "the use of aluminum in any aircraft part is prohibited" and further that—by other government specifications—"the use of welded items in the control system is prohibited."

To give a specific instance—in 1920 the writer suggested the use of welded aluminum tanks and was looked upon with horror by all departments. It was perfectly clear that a heavy gage solidly welded aluminum tank (not even duralumin) was stronger, lighter, cheaper and certainly much more reliable than the existing riveted and soldered steel tanks that were rattling themselves to pieces all over the world.

It was only by continued argument, continued persuasion and exhaustive demonstrating tests that permission was finally obtained grudgingly to introduce this item—now standard the world over.

It would burden this article too much to disclose the dozens of instances of this sort of delay in development which other constructors in America have experienced in their history. But, the general conclusion to draw is this—development is hindered greatly by the government drawing up specifications for new aircraft and furnishing them in detail to the constructor. The government engineers are not inventors, they are not developers, and they are not practical constructors. They are extremely well-informed, well-intentioned aviators with a thorough military background. Their ideas of specifications for new aircraft must psychologically inevitably be based on their own knowledge of old previous aircraft that they have used. When they specify what they want to have, they cannot draw upon any new fund of imagination or prognostication of what they could get.

As a result we have the very definite process still going on—that the Army and Navy want next year's advanced plane built on last year's specifications thus completely putting the cart before the horse. The solution is simple. The first request of the government in a new development should be that the experienced constructor write out new specifications as he sees them. This is purely as a guide to the government to indicate what is coming. The constructor should be given the performances of the best then existing planes in service of that type and told that the government would like at least—let us say—20 miles more high speed, 5,000 feet more ceiling, so and so much more load and such and such additional equipment. The constructor should then be gently kicked out of the office of the Engineering Division and told never to show his face there again until he arrived with his airplane to demonstrate the achievement of these performances.

The whole system of approvals, of drawings, etc., on experimental aircraft that is now done seems like an utter waste of time and greatly limits the inventive talent of the constructor. It is only a necessary system where the constructor is incompetent or untutored in the details of aircraft construction like some of the automobile companies. But if the constructor is incompetent, the government should probably not have given him the contract in the first place. And if the constructor fails in his new development assignment he has just that much less chance of ever again being asked by the government to do any more work.

We will never know how many brilliantly and amazingly successful new developments we have missed by not using this system because it has just been impossible for them to be born.

A still further interesting lesson to be learned from the last 25 years is that no new development in aircraft design that involves increase in speed has ever failed to finally achieve success no matter what the cost or the limitations. If greater increases in speed need prohibitively large airports, lo and behold the airports are finally built. And the reverse of this axiomatic principle is also found to be true, and that is, no element introduced into aircraft that reduces speed such as slots, flotation features, mufflers, etc., ever survived.

Let us take an admittedly limited glance at some of the high points in the development of loads, construction, controls, types and sizes, accessories, etc.

Wing and Power Loadings

Progress of aircraft design in twenty-five years means spanning the gap from the J.N. training plane to the Douglas B-19. In the year 1916 there had already been very material progress since the birth of practical aviation in December 1903. For one thing the pusher type airplane had practically vanished from the scene. The biplane was in universal predominance. Fuselages were universally enclosed.

Two years of war had already taken place and guns were being mounted on the Sopwith, Nieuport, Fokker, and Albatross fighters of that day. A general résumé of the technical data of the average planes of 1916 compared with what we find 25 years later gives a revealing insight into the details of development.

What interests everyone first seems to be wing loadings. Well, in 1916 the wing loading of the Curtiss J.N. was 6 pounds a square foot and wing loadings of contemporary planes varied from slightly less for so called high-altitude planes and fighters like the Sopwith to some 8 pounds a square foot on more heavily laden two-seater planes that were designed to carry additional guns.

One of the famous Loening amphibians which came into such prominance about 1926. This ship familiarized both Army and Navy with retractable landing gear

Designed in 1928 this Alexander Eaglerock Bullet was the first low-wing cabin plane and the first cabin plane to have retractable landing gear. Cruising speed with a 100 hp. Kinner was 113 m.p.h.

and some of the early types of bombs.

It was only in 1918 that the overloaded DH-4 and the LePere—and also the 300 hp Spad—began to flirt with the then dangerously high wing loading of 10 pounds a square foot. Compare this to the 40 and 50 pound wing loadings that we so lightly consider today!

Since the early Wright plane of 1903, wing loading had increased from 2 pounds per square foot to 10 pounds in 15 years—a five-fold increase—so it is not so out of line to have wing loadings again increase five-fold in the span of another 20-odd years. But what are we going to do in another 20 years if we still have this five fold increase and are flying planes with a wing loading of 250 pounds per square foot—or is this, perhaps, going to be the era of boundary layer control which will permit of this? After all, modern flaps brought our present great increase in permissible wing loading.

As to horsepower loading, the training planes of 1916—most prominently the Curtiss J N. and the Avro 504-K—had power loadings of around 20 pounds to the hp.—the hp., however, being a very questionable quantity.

The Curtiss OX was charitably rated at 100 hp. but could not possibly get any such figure under present day tests. The Avro was powered by a 110 LeRhone which used up a large portion of this horsepower to drive itself around so that no such net horsepower arrived at the propeller.

More advanced fighting planes of that era such as the Sopwith, the Halberstadt, the early Spad, the Fokker, and the Albatross came down to around 11 to 12 pounds to the horsepower. But a most startling step was taken in this direction with the advent of the British Rolls Royce DH-4 and the American Liberty engine DH-4 which by 1918 were using 400 hp. to lift 3,700 pounds and had passed under the magic figure of 10 pounds to the horsepower.

Today we have planes of this general character in the two-seater class rated around 4 to 6 pounds per horsepower. The reduction in pounds per horsepower also seems to follow somewhat in the same ratio but, of course, cannot continue very much further even though fighters of the present day are beginning to flirt with the 3 pound per horsepower era which is pretty near the limit of what we can get to on this score with any kind of load capacity.

Construction

In construction details, 25 years have brought many changes. Probably no other branch of engineering has seen so profound a metamorphosis of fundamental structure.

The 1916 airplane was a wood and wire structure, fabric covered with mostly (in America) a water-cooled engine.

Twenty-five years later the externally braced biplane wing cell has given way—in the military field—to the all-metal, stressed skin, cantilever monoplane in universal use in all sizes, except in a very few training planes and even these are fast being outmoded.

Fuselage construction of wooden stringers and posts with wire bracing so familiar in the J N. gave way first to veneer covering as in the DH-4, the Curtiss Oriole and the L W F of 1918 to 1920. Meanwhile another trend had developed in the construction of fuselages using welded steel tubing. This was exemplified in the Fokker D7 which was the first plane in large production to use the welded steel tube fuselage. This steel frame construction is still quite widely used commercially and has many merits and a persistent survival. It is weather proof, light, strong, capable of reasonable quantity production and quite easy to maintain.

The wing covering of cotton or linen fabric doped with cellulose acetate or its equivalent, still so popular, was not good at resisting weather in the early days and was very inflammable. It still has much merit—is cheap, light, and has been greatly improved. It will be hard to improve upon for light planes.

The advent of veneer in 1918 as a desirable material was further emphasized in the veneer spar cantilever wings of the Fokker D7 biplane and the little veneer covered wing of the Fokker monoplane which was a sensation until wing flutter (as yet unknown in nature) caused several accidents and finally abandonment—again a lesson in the lack of patience and persistance and the building up of prejudices by pilots that temporarily block the engineers' path.

In 1922 the Junkers JL6 single engine cabin plane appeared and was the early forerunner of the low wing cantilever type. For several years it stared us all in the face. We knew how sound it was but the prejudice of aviators against change was too much to overcome and none dared emulate it until Stout with his Ford planes boldly led the way to be followed only in 1930 by the Boeing "Monomail." This was shortly succeeded by the old Boeing 247 (for photographs see the article page 68) as the first really successful American low wing, all metal, cantilever, cabin plane. Northrop also entered early in this all metal field and of course the Ford planes remained outstanding in use of duralumin although the Ford planes were all high wing. These old Fords, still running in many parts of the world after a life already of almost 15 years, are convincing testimony of the excellence of their construction. But here is an instance of a constructor failing to continue his development. Why did the Ford Co. quit with its excellent plane? A long range peek over the horizon would have shown that accidents to his planes and deaths of the test pilots were discouraging to be sure, but were only incidents and should in a hard-boiled way have been overlooked. (See page 212 for photograph.)

As to veneer in construction, it has persisted through the years with a decreasing popularity until the arrival recently of phenol base veneers (so erroneously labeled as "plastics") and with this weatherproof and excellent homogeneous material the return of wood aircraft is becoming evident daily. The new veneers are easier to form in great pressing operations, are fire and weather resisting to a high degree and have new popular appeal in their being propogandized as "plastics" ushering in a new age. We still find in this material one of the old bugbears of veneers—an uncertain brittleness.

Controls

During this era, the height of veneer construction of aircraft was found in the Savoia twin hull flying boats which not only had veneer covered hulls but also cantilever veneer skin wings. These craft reached their climax in the great Balbo flight from Italy to Chicago in the summer of 1933 when 25 of them in squadron formation flew from Italy to Chicago via Iceland and Labrador—

23 of them returning safely—an epic flight often overlooked

It is fascinating to look at the silhouettes of aircraft in the last 25 years and see how the rudder and fin have risen in height—we might say so many inches a year. A high rudder and fin with not too deep a chord would have solved the lateral control—introduced the needed self-banking and placed the fin area in undisturbed air—giving directional stability that was so badly needed on many an early plane. Why none of us—and there is not a constructor in the country that does not escape censure—appreciated the simple lessons of this development is a mystery. We have but to compare the rudder and

The Ford Trimotor, designed by Bill Stout and one of the great pioneering airplanes of the United States. Many Fords are still in operation after 15 years of service.

fin of the original Curtiss J N of 1916 with the Fairchild 24 of today to see how relatively minor the difference is and yet how very important. Likewise a comparison of the Curtiss Flying boat of 1916 with our Commuter of 1930 shows an even greater difference and yet one structurally attainable with ease in 1916 had the necessity of this disposition been known.

On lateral control it took many years for constructors to realize that one of the reasons that ailerons were stiff was simply because the wing twisted so that the aileron that was increased in incidence (to get the necessary aileron lift) lifted the rear spar instead—thus reducing the angle and the net lift of the wing on the side it was desired to raise. The solution of this wasn't the balanced ailerons that flourished in the early twenties—it was simply more torsional rigidity.

Of course, as already mentioned, one of the mystifying and difficult features of aircraft that at first began seriously to receive investigation in 1926 was that of wing flutter and mass balancing of controls—all pretty simple conceptions that had nevertheless not been thought of up to that time.

Before leaving controls let us not forget that in 1916 there were in use in the United States three different types of controls, and pilots were supposed to learn on all three of them to be really proficient and not supposed to pass from one to the other unless they were pretty "hot." The controls were the old Curtiss shoulder yoke, "Dep", and the stick control which was then relatively new—believe it or not.

Accessories

In 1916 aircraft had no starter—no cockpit enclosure—certainly no soundproofing—no variable pitch propeller, few adjustable stabilizers, and no brakes. The three-wheel landing gear of the early Curtiss pusher planes had been completely abandoned (only to be revived now as something sort of new). It is quite true that weight limitations prevented the addition of many of these accessories, but, nevertheless, many a crack-up could have been saved by a very slight addition of weight in the form of brakes. But nobody demanded them and the competitive aspect of someone starting to use them and forcing the others to follow suit just did not take place. Brakes began to appear only in 1930.

Oleo landing gears came on the scene seriously at the end of the 1920's. Rubber shock absorbers had been used previously to that with great success and there is still much to be said in favor of rubbee with its great hysteresis loss furnishing an ideal bounce shock leveler.

The lack of instruments and radio, of course, meant that flying was greatly limited in 1916 compared to 1941. Blind flying was not attempted at all. Rains and thunder storms grounded planes all over the country. In fact, very high winds were also frequently a cause for canceling flights. The lightly loaded planes of that era were by no means happy and comfortable on a field with a 35 mile wind blowing because of their chances of being upset.

The Streamline Urge

Despite the excellent effect that racing had in developing higher and higher speeds, it is amazing how long it took the obvious streamline lessons learned to be incorporated in service aircraft. The Supermarine racer of 1927, further developed in 1929 and breaking all world speed records, could easily have been a Spitfire by 1930, but it took the British no less than seven to eight years to incorporate its lessons into service aircraft.

Lawrence Sperry in 1919, and the Dayton Wright "Alerte" a couple of years later, demonstrated conclusively the practicability of retractable landing gears. Even in the Pulitzer Trophy Race of 1926 the Verville racer demonstrated conclusively the ease and practicability of retracting the landing gear. Meanwhile the Loening Amphibians—which were then beginning to come into wide use in the Army and Navy—were familiarizing the services with retractable gears and still nothing startling was adopted along this line until 1930 when several constructors suddenly began to realize how much they had to gain by folding their gears. In the transport field Douglas in his DC-2 was distinctly the first to introduce retractable landing gears into a large sized aircraft with tremendously beneficial results.

Even the Curtiss Hawk of 1926 could have had a retractable landing gear and so could have the Boeing F4B—which particularly in the latter plane would have made a tremendous difference in its performance. And yet the little experimental Alexander "Eaglerock Bullet" of 1928 was really the first low wing retractable gear design in the country and no one paid the slightest attention to it.

Through the last 25 years there have lasted without interruption continued arguments as to multi-engined against single engined aircraft. Lately, however, this is tapering off because in retrospect we now realize so clearly the correct analysis of this feature. Twin-engine aircraft were without a doubt more dangerous than single-engined aircraft unless they could fly adequately on one engine. Curiously, by the time they were developed to the point where they could fly on one engine—the engines themselves had been developed to such a high state of reliability that the argument of safety in duplication seemed to have lost its potent meaning.

Now actually while the argument of reliability by duplication has been and still is used to point out the safety of multi-engined equipment, the facts are that there is much more real reason for the survival and even increase of multi-engine design. The real reason is to pack more horsepower into a given airplane than can be given by a single engine of the largest size now available.

This leads then to the consideration of the increase in size of aircraft. Twenty-five years ago the largest air-

craft that had flown was the earliest four engine pioneer effort of Sikorsky The 1916-17 version of this had four Renault motors of 220 hp each Toward the end of the war a huge Zepplin Maybach plane was built in Germany—134 feet in span and driven by four 300 hp Maybach engines The British had an answer to this in the four-motored Handley Page bomber which flew the last year of the war And over here, of course, we developed in 1918 and early 1919 the famous NC Flying Boats which subsequently were the first to cross the Atlantic ocean The NC—fully loaded—weighed 28,000 pounds—carried a useful load of 12,000 pounds and did this with a loading of 17.5 pounds per horsepower and a wing loading of slightly over 10 pounds a square foot There were other large size planes in this era such as the Caproni Tri-motor and a couple of feeble efforts in France like the Voisen Tri-plane.

It is interesting that all of the multi-engined aircraft of this era were either biplanes or tri-planes—all with a mass of struts and wires, very badly streamlined, little regard to finess ratio, and accent on getting lots of wing area to carry a big load

In 25 years we have progressed through a long series of such developments to the Sikorsky S-40 of 1931 and the subsequent Sikorsky Clipper and Martin Clippers of 1934 and 1935 in the form of strut-braced mono-planes and finally to the clean cantilever wing design of the Boeing B-17 and the Douglas B-19

In 1929 appeared the Dornier DOX which also was a strut-braced mono-plane of over 5,000 square feet in area—the largest wing surface ever built. The figures on this forerunner of the giant planes—unsuccessful as it was—are nevertheless interesting. The gross weight was 113 000 pounds and the weight empty was about 60 000 pounds The wing loading was 22 6 pounds a square foot and the power loading 18 pounds per horsepower This plane was equipped with 12 engines of 500 horsepower each and carried a passenger and crew load of 112.

How interesting it is to compare this with the B-19 which has approximately the same horsepower loading—cruises at over 200 m p h instead of a bare hundred, has a gross weight of 160 000 pounds and carries 11 000 gallons of gasoline instead of the 4,000 carried by the DOX

Here is 12 years of tremendous progress in design and striking evidence of the importance of streamlining

As to the constant argument over the relative merits of the biplane and the monoplane, it is interesting to recall that in the period from 1916 to 1923 this argument was so violent as frequently to lead to blows In a majority of cases the monoplane as such was in high disfavor with pilots and looked upon with suspicion—considered fundamentally weak and tricky and to be avoided at all costs. It is hard to conceive of this situation when we look around today and find the world of aviation expressing itself almost universally—both in a military and a commercial way—in the form of monoplanes with an occasional biplane trainer or private plane as a curious survival of an era that has passed Actually the biplane still has many points in its favor but as indicated previously the chief reason that it has finally succumbed is because it is definitely slower and speed—always speed—gives all the commands in aviation development (a fact that all engineers in this field must learn as a fundamental)

In over water flying—particularly the commercial angle—25 years of progress has still not decided the question of whether landplanes or seaplanes should be used. In the first phase of its operations from Florida to Cuba in 1929 Pan American Airways used tri motored landplanes Then with the advent of the Commodores and the S-40's the swing went to the use of flying boats Now, over this identical route the swing is back this year to the use of twin-engined landplanes and a definite indication that this the only company in our over-seas air commerce, is going to go all out for landplanes to succeed the Clippers in the trans-oceanic services

It would take too much space here to analyze all of the reasons why the record shows these moves were consistently wrong at the time Suffice it to say, right now, that technical indications are pointing to the fact that flying boats in large sizes—200 000 pounds and up—such as are needed for trans oceanic service—will be more efficient than land planes of similar size so the most recent land plane choice for over-seas seems wrong again Huge flying boats will be just as fast—will get more load into the air—and carry more useful loads due to the dispensing with the tremendously heavy landing gear in any such sizes So, if this prognostication is anywhere near correct, our over-seas airline company is wrong again in this regard.

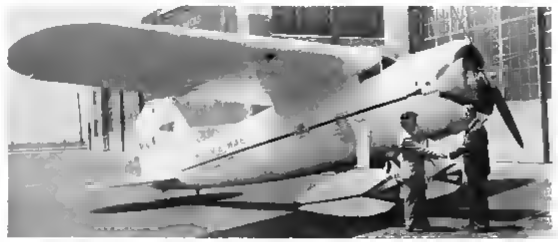
The same confusing sort of tendencies and judgments seem to have existed in the last quarter century in the Army and Navy The Army for coast defense could certainly use to very great advantage large squadrons of seaplane bombers—because they can be scattered all over the coast of the United States in any harbor—would permit a great flexibility in bases and at bases that could not be destroyed by bombing The Army has no such squadrons On the other hand the Navy with its long range scouting operations to be done in the shortest possible time should have the fastest long-range planes which in the present size are clearly landplane type It has none of these

In short, in 25 years we cannot find that judgment in choice of types has progressed any better than it has since the early beginning when similar errors were so prevalent

Conclusion

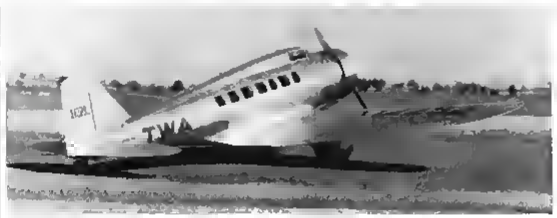
In 25 years the use of aircraft in the United States cannot be better emphasized than by the fact that in 1916 an exhaustive investigation by the War Department showed that there were only 817 air pilots in the United States who even remotely qualified as flyers—where as today we have by now over 120,000

From a few hundred workmen in 1916 engaged in building aircraft we now have 500 000 And, where in 1916 our own government had a total of less than 50 military planes in its possession—today we are fast nearing having 50 000 Nevertheless even with this



Wiley Post's famous Lockheed, Winnie Mae. This 1930 design had a laminated wood fuselage. With Wiley here is Col. H W. Lake of Socony-Vacuum.

ROBERT YARNALL RITCHIE



The Northrop Delta, of 1933. This plane might have made history if the government had not ruled that twin-engined ships be used for over-mountain airline flying.

tremendous expansion some of the lessons of this last quarter of a century still have a vital and important meaning.

The outstanding contribution of American aviation to world progress in this field is the tremendous play that was given during the era to private initiative. Our privately-owned airplane development grew to such a degree that just before the war we had more privately owned airplanes in the United States than all the world put together and the type of planes that had been developed by our industry—the Fairchilds — the Stinsons — the Beechcrafts — the Wacos — the Lockheeds, etc., were universally in demand all over the world. The other phase of our commercial air development—the growth of the airlines—has not only been phenomenal due to the excellent basis of competitive effort that we forced on ourselves with such success, but it has also been universally acclaimed in that the American aircraft that were developed by our private industry for this work—particularly the Douglases and the Lockheeds—were eagerly grabbed up by the airlines of all other nations and used by them throughout the world.

In retrospect we can say that in this country at least commercial and private air initiative has done a great deal for military development which military development alone would not have been able to do.

It was the demands of the airlines and the private owners for efficiency, speed, ruggedness, reliability, and beauty that developed the technique of building the present American all-metal, cantilever-wing monoplane with retractable landing gear and variable pitch propeller to such a high degree as to serve as a most successful background for subsequent military development.

But we cannot pass from this subject without recalling that after all it is true that there is nothing very much new under the sun because in 1911 the Antoinette Company in France had developed a low-wing cantilever monoplane — considered a freak — but strangely prophetic of what was to come 25 years later.

Materials

(Continued from page 202)

molded plastic propeller (fabric impregnated with phenol formaldehyde resin) was developed at this early period with mechanical properties equal to any modern plastic.

There was no substitute for the tin for engine bearings in 1917, but in the intervening period, copper-lead and silver bearings have eliminated the possibility of tin shortage affecting engine production. The tinned steel fuel and oil tanks are now aluminum, magnesium, and in combat airplanes, flexible plastics.

The present situation is not normal. The desirability of conserving metal for the more essential parts of combat airplanes has caused a great deal of emphasis to be placed on wood, plywood, and other non-metallic materials. Whether these materials will continue to be used for the primary structure after the emergency is problematical.

The increased application of metal in light airplane construction was a significant trend before restrictions were invoked. Research in the development of new alloys is unabated. Ingenious and novel methods for processing and joining parts will permit more economical production.

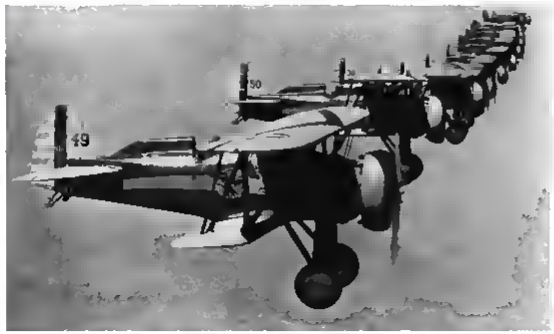
The months to come will bring many changes in the use of old materials and in the development of new materials. These will be watched with interest.

The aviation industry revolves around a large, highly trained engineering staff which is youthful and progressive and can be depended upon to exploit any material or process which offers a chance of success.

Army Aviation

(Continued from page 55)

aviation, grow from a minor adjunct of communications and ground forces into a powerful prime weapon, co-equal in importance with stream lined mechanized divisions and naval flotillas. Air power has revolutionized the technique of military operations. Dive-bombing, mass assaults by heavy bombers, parachute troops, glider trains, troop transports, air-borne artillery, incendiary raids and torpedo planes are but a few of the functions in which aircraft is proving its military valne in World War II.



By 1932 these Boeing P-12E's were the hottest pursuits in the Army. They belonged to the 27th Pursuit Squadron at Selfridge Field. Air Corps photo

Aviation in the World War

At the beginning of 1917 the United States ranked about fourteenth among the nations of the world with respect to numbers of aircraft. The declaration of war, on April 6, found this nation's air service and its aircraft industry sadly inadequate for the task ahead. It may be noted that the lesson learned at such painful cost in the months to follow has served well to guide our military leadership and civil industry to a better preparation for safeguarding our national security in the present emergency.

It was not until September 1 that the First Aero Squadron arrived in France. In the meantime, Congress during the summer had appropriatel $640,000,000 for a gigantic aviation program.

Civil aviation was then virtually non-existent. Mass production was just beginning to be practiced in older established industries. Needless to say, the aircraft industry was totally unprepared for the demands made upon it. Nevertheless, in spite of the errors and confusions and attendant headaches and heartaches, the miracle of mass production of airplanes and engines was achieved in a remarkably short time.

Rudy Arnold

Today the Air Corps has a variety of fast pursuit ships. Here, left to right, are the Lockheed P-38, Bell P-39, Curtiss P-40 and Republic P-43.

Few Americans recall it now, but within that 18-month period of war effort our industry produced more than 20,000 planes of all types and 30,000 engines. Actually, by November of 1918 when the war ended, *the rate of production* of our aircraft industry was in excess of 23,000 planes a year!

However, the big drawback, even then as now, was the long time-lag between placing of orders and quantity deliveries, where "production capacity" was nonexistent or very limited. Except that in modern industrial warfare this factor grows increasingly important and ever more critical.

At the opening of the war, the United States did not have a single service-type plane suitable for actual combat operations. Consequently, there was a period of study and preparation before the best available designs could be established and placed in production. The DH-4, most important of the American-built combat ships, was ordered into production October 18, 1917, less than 13 months before the Armistice was to be signed.

Some allegations subsequently publicized to the effect that only a handful of American-built planes had reached the front by the Armistice date are erroneous and belittle the really remarkable accomplishments of our aviation leaders and the industry. The first American-built DH-4 arrived in France May 11, 1918 and began reaching France in quantity during July. Early in August an entire squadron of DH 4's, with Liberty engines, was operating over the front lines.

In the meantime, the Air Service was by no means idle. Thousands of pilots were trained and sent abroad and equipped with aircraft and supplies procured from the Allies. Early in 1918

military aviation was already coming into its own. In a sweeping reorganization ordered on May 21, 1918 all aircraft activities were divorced from the Signal Corps and two new aviation departments created—the Bureau of Military Aeronautics and the Bureau of Aircraft Production.

Out of a total of 6,287 planes delivered to the AEF prior to the Armistice, 1,216 were American-built service planes—no mean achievement for scarcely more than a year's production effort and especially in view of the acute problems of transportation involved.

Although Congress appropriated in excess of 1½ billion dollars for military aviation purposes during the war years, actual expenditures for aeronautics during the War were approximately $868,000,000. Just contrast these figures with those for the present preparedness period and the intervening years which are shown in the accompanying chart and reflect how much greater those sums need must be if the United States were **at war!**

Boom Years and Lean Years

The impetus given aviation development by the exigencies of war carried on through the years immediately following. Aviation officers established new records month after month, flying higher, faster and farther than ever before. In the fall of 1921 Lieut. John A. Macready took a LePere up to 37,800 feet. The following year, Gen. William "Billy" Mitchell established a new world speed record of 224.38 miles an hour over a measured kilometer.

Lieutenants O. G. Kelly and Macready flew nonstop across-continent in May, 1923. A year later the Air Service again made aviation history when its Douglas World Cruiser successfully encircled the globe in a magnificent journey of 27,553 miles. And so it went. Such familiar names as those of "Jimmy" Doolittle, Russell Maughan, Maitland and Hegenberger and others too numerous to list were on the lips of every American boy from coast to coast. George Goddard then a Lieutenant also, made the first successful flashlight photograph at night from an airplane in 1925.

And in this way, though handicapped by limited funds, the air service continued unceasingly with its work of research, development and testing. Air service technicians and pilots pioneered in night flying, aircraft radio communications, instrument flying, aerial navigation and so on. They devised new instruments and equipment, better ways of building and controlling airplanes. As soon as each innovation was proven it was immediately released for the benefit of our commercial aviation interests. Thus, to the air service is due no small share of the credit for the world superiority of America's commercial aviation and its products and services. This is the more remarkable when it is considered that the total appropriations for the Army air service during all the years following the first World War up to fiscal 1941 was scarcely half of the sum expended for aviation during the brief time the United States was at war.

Emergence of Air Power

In the early years of the last decade air power began to emerge as one of the major weapons of the "strong arm" powers. By virtue of its potential though untried threat to the safety and morale of civilian populations and to the industrial resources behind the lines it became the "big stick" of unscrupulous diplomats at the international conference tables.

In recognition of these and other factors of military importance, the Drum Board, comprising outstanding general officers of the line and the Chief of the Air Corps, in 1933 made the initial analysis leading to the creation of the General Headquarters Air Force in 1935. This was strictly a combat team, filling the need for a highly mobile and powerful striking force that could be moved quickly from any part of the country to another.

Our military leadership recognized that the unique feature of air power, as compared with military or naval power, was that it could be applied directly against the enemy without *first* overcoming land or sea barriers or the enemy's forces. Therefore it was no accident, but farsighted judgment that led the United States to pioneer in the development and production of the superb "flying fortresses," huge multi-engine high performance bombers capable of carrying tremendous forces of destruction far into enemy zones to prevent the establishment of advanced bases from which the enemy can attack us.

The Components of Air Power

Air power is not measured by numbers or quality of airplanes alone. It consists of three vital elements—aircraft, trained combat crews and the necessary air bases with service personnel to support the combat units. Though it has been more widely publicized, the present effort to secure the best fighting planes in the world in large quantities in the shortest possible time has not led to the neglect of the other two elements.

With the dollar volume of its program stepped up nearly a hundred times within the space of a year, the War Department was faced with a problem of aviation personnel training as acute as that of production. The quality of training given Air Corps personnel has long been acknowledged as of the finest in the world. The amount and quality of training could not be decreased without weakening the entire structure. As a matter of fact, due to the increasing complexity of modern aircraft a proportionately greater amount of training is necessary.

Therefore the current expansion program is being accomplished by intensifying and speeding up training rather than by cutting corners. The air force is utilizing the facilities of established commercial aviation schools on a wide scale. It is now nearing a rate of training of 30,000 pilots and 100,000 mechanics a year, with corresponding increases for navigators, bombardiers, observers and gunners. Whereas the Air Corps had one primary, one basic, and one advanced flying school prior to the emergency, there are now 41 civil primary flying schools under contract and 18 basic training schools under operation or in process of construction. Advanced training schools are being increased to 21. Additional facilities are being provided for training in gunnery, bombardment, meteorology and navigation. Schools for instruction in other mechanical and technical subjects are being vastly expanded and increased in number.

In consequence of the foregoing, as the combat planes roll off the assembly lines in ever increasing numbers, trained pilots, combat crews and ground service personnel will be on hand to give them meaning.

Air bases and ground supply constitute the third element. On July 1 there were approximately 128 air stations located at some 109 landing fields throughout the continental limits of the United States. These figures are not stated exactly because with the rapid expansion of all activities and extensive construction in progress the total is constantly increasing.

Thirty-four of these stations are major air bases and the remainder comprises air depots, tactical stations, school units, experimental and auxiliary fields. The figures do not include the so-called "overseas bases." They are not part of the Army Air Forces, but fall under the Defense Commands of the War Department proper. These air bases of the Defense Commands are located in Alaska, Hawaii, the Philippines, Panama Canal Zone and the off-shore Atlantic area from Newfoundland to Trinidad.

U. S. Air Power Today

We see now how essential it is to maintain a precise balance between the three elements making up effective

Army Aviation

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air power. It can be only as strong as the weakest of the three links. Above all there must be a supremely accurate coordination of all three—an organizational "brain" to weld the diverse components into a fast-working, hard-hitting fighting team.

This objective was further implemented by the recent order which established a new unit known as "The Army Air Forces." This provides a complete unification of all the War Department's air activities under a single head. This development marked no abrupt change of policy or sudden departure from approved practice dictated by immediate circumstances but is part of the evolutionary process which has been going on for years in the War Department. During this process the air activities have received more and more independence and the present setup gives them autonomy within the War Department.

Here is the plan of organization in brief. Pursuant to policies, directives and instructions from the Secretary of War the Chief of the Army Air Forces is charged with the control of the Air Force Combat Command and of the Air Corps and the determination of requirements with respect to personnel, supplies and finances for the Army Air Forces. He is also responsible for the supervision and coordination of all other air units.

The Air Force Combat Command as the title signifies comprises all combat squadrons with the exception of those units thereof assigned or attached to task forces, oversea garrisons or other commanders. It must prepare plans for defense of the continental United States against air attack; develop doctrines of air tactics and technique of the Air Forces; conduct operational training and make tactical inspections of Air Force units assigned or attached to other commanders. It also exercises command and control of all Air Force Combat Command air bases and stations including personnel and installations and even holds court-martial jurisdiction over all elements of the Combat Command.

The Air Corps is charged with the supervision of activities in connection with research, development, procurement, storage, supply, maintenance and disposition of military aircraft facilities and appurtenances. The Air Corps also conducts all training with respect to pilots, specialized nonpilot functions of combat crews, and duties involving the maintenance of aeronautical material. It is responsible for the establishment and operation of the necessary schools for these purposes as well.

Finally, the Air Council was created for the purpose of periodically reviewing and properly coordinating all major aviation projects of the Army and passing on matters of current policy. It is composed of the Assistant Secretary of War, ex-officio; the Chief of the Army Air Forces who is president of the Council; the Chief, War Plans Division (General Staff); the Commanding General of the Air Force Combat Command; the Chief of the Air Corps and such other members as may be appointed from time to time by the Secretary of War.

The Present Effort

It was a little over a year ago that President Roosevelt, in his memorable defense message to Congress after the fall of France, declared that the United States should have 50,000 airplanes. We are definitely on our way toward that goal, as close to schedule as we dared hope to be at this time last year.

The agonizing period of toil and waiting without results between placing of mass orders and the beginning of quantity deliveries is now about ended. The industry which last year produced approximately 6,000 military planes has now reached an annual rate of production of about 18,000. This rate will be doubled by the first of next year and sometime during 1942 the industry confidently expects to reach a rate of production of 50,000 planes a year!

This is the picture expressed in dollars. In 1939 the industry did a quarter-billion dollars worth of business, in 1940 the dollar volume of output reached $544,000,000, this year the industry proposes to produce one and a half billion dollars worth of planes. The War Department alone in the past year has expended and obligated approximately $3,000,000,000 for aircraft. The actual number of airplanes on hand and on order cannot be divulged, but I can tell you that right now our aircraft industry has orders from the United States military services and the British for 80,000 planes—and the end is not yet.

In other words, we are trying to do in two years what Hitler did in about six years—and we are succeeding. This is but another proof of the unbeatable partnership of democratic government, free enterprise and unshackled labor. We cannot afford, however, to pause for rejoicing nor relax in our efforts. We must simply take heart from a splendid beginning and toil harder than ever to the end that our free partnership shall long endure.

Messerschmitt

(*Continued from page 102*)

However, the equipment as a whole will not meet our requirements which we impose on our commercial equipment with respect to performance under various temperature and humidity conditions. The German equipment will not pass our tests for operational characteristics over a temperature range from —40 to +150°F. Furthermore, since the various metallic surfaces of the German equipment were not protected against corrosion, it could not pass our standard humidity test. In this connection, it should be noted that none of the coils are impregnated with a protective coating of wax; our standard humidity tests would certainly render the equipment inoperable, if not wreck it.

The high degree of standardization of German radio apparatus is further evidenced by the use of identical connection plugs and sub-assemblies, and even minor components, in a great number of various types of German military aircraft radio apparatus. Thus, beginning with the types developed around 1933 when Germany first started actually preparing for war, and down to the latest types developed only last year these same components and sub-assemblies are constantly recurring.

This is symptomatic of large-scale quantity production of radio equipment, and indicative of interchangeability not only of the various components within the radio apparatus, but also of the radio apparatus itself in the various types of aircraft. It should be noted that this procedure, although effective in overcoming production problems, imposes certain grave penalties on the nation adopting it.

Construction of the transmitter. The variometer shown is long outmoded in this country.

In the case of German equipment in general, and that of the Messerschmitt 109 in particular, the heaviest penalty is imposed by the necessity of adhering to obsolete and obsolescent design practices. In some respects German equipment is at least ten years behind commercial practices in this country, although it is known that better designs are available. These better designs, however, only began to become evident in the latest German aircraft, indicating that a basic new restandardization is apparently in progress, and that more advanced designs and production methods are about to replace the type of equipment exemplified by the Messerschmitt 109 radio apparatus.

Description of Apparatus

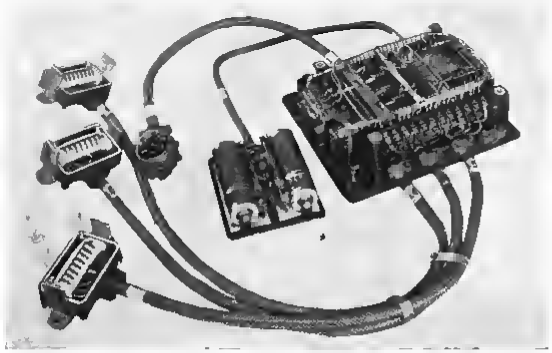
Examination of the radio equipment from the Messerschmitt indicates very definitely that it is intended primarily for communication over very limited ranges. The equipment is comprised of a low-power transmitter sufficient for interplane communication, a receiver, and a power supply unit. The receiver is relatively insensitive, and the transmitter output is so limited that it cannot be picked up by the enemy at a distant location. The frequency range of the equipment is from 2500 to 3700 kilocycles which in itself represents a very narrow band for communication purposes. Both the receiver and the transmitter are tunable in this range of frequencies.

The equipment weighs in the neighborhood of sixty pounds and the approximate dimensions for the various units are as follows:

Unit	*Dimensions*	*Weight*
Receiver	13⅝"×9⅞"×6¾" high	13 lb
Transmitter	8¾"×13½"×7½" high	28 "
Dynamotor & Filter	9⅝"×4¾"×9" high	13 "
Junction Box & Cables	4⅝"×9½"×3⅛" high	15 "
Resistance Units	4½"×5⅛"×2" high	2 "

As far as the size and weight of the Messerschmitt radio equipment is concerned, it should be mentioned that it is possible to obtain commercial equipment in this country which will give much better performance and yet be considerably lighter and take up much less space. Specifically, Lear Avia manufactures a transmitter and a receiver, complete with a shielded loop for aural-null direction finding, which weighs less than half that of the Messerschmitt equipment and the entire three-way Learadio system takes up less space than either the German receiver or transmitter. The Learadio equipment has much better sensitivity, and the output of the transmitter is about four times as great as that of the German equipment. From this comparison it would appear that we, in this country, have progressed further with the development of lightweight aircraft equipment in commercial fields than the Germans have with their military equipment.

The receiver has a single band, tunable over the frequency range of 2500–3700 kilocycles. It employs a superheterodyne circuit and contains five shielded Telefunken RENS 1264 tubes used as follows: first RF, detector oscillator, first IF, second detector, and audio output. The filament voltage on these tubes is 4 volts, and the plate lead is brought out at the top of the tube. These tubes are the equivalent of our Nos. 24's or 35's; their design is at least ten years old. They have been obsolete for more than five years and are no longer used in this country. The RF detector uses an old type autodyne circuit which is not at all suitable for high frequency operation and has been radically revised through the use of newer types of tubes.



The very ruggedly constructed junction box.

Ceramics are used extensively in the equipment for terminal boards, coil forms and tube sockets. The coils in each case are air-tuned and no iron-core coils are used except in the second IF transformer. This is significant because Germany has pioneered in the development and application of iron core coils. The receiver output circuit is designed for 8000 load, and the maximum power output is approximately 70 milliwatts. The receiver sensitivity is approximately 10 microvolts at the high frequency end of the band, and varies up to 60 microvolts at the low end of the band. The IF frequency of the receiver is 520 kilocycles, and the first IF transformer is double-tuned whereas the second IF transformer has only one tuned circuit.

Ceramic resistors and condensers are used extensively in the receiver, and these are color-coded for ease in wiring. In every case these are mounted on ceramic terminal boards. The various leads used in the wiring of the receiver are covered with varnished cambric tubing and then laced into place. A very hard solder is used, apparently containing a high percentage of tin, thus facilitating necessary connections. When special sub-assemblies are fastened by screws, cement is used to lock these in place, current practice in this country is to use an approved type of lock washer for this purpose.

The transmitter consists of four tubes arranged as follows: a Telefunken REM-904 tube used as a straight feedback oscillator, the frequency of this oscillator is controlled by a tuning condenser in the plate circuit and is indicated on a dial on the front panel of the set. The output of this oscillator is fed to two Telefunken RES-1664D tubes in parallel, which function as grid modulated RF amplifiers.

The modulated equipment consists of one Telefunken REM-904 tube. Provision is made for another REM-904 tube to be used in conjunction with the present one so that more audio voltage can be applied to the grid of the power amplifier tube when they are subjected to high plate voltage.

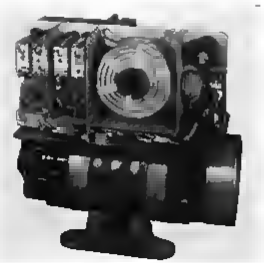
The antenna system is connected with the set through a "fixed-trailing" antenna switch and a variometer. This antenna system consists of a short fixed antenna and a conventional trailing wire type. The circuit is so arranged that when on fixed antenna position the ship serves as a counterpoise; when on trailing antenna position the fixed antenna and the ship serve as a counterpoise.

The filter for the power supply and rectifier for the bias voltage are contained in the transmitter unit itself. Power output for this unit is approximately 2 watts.

In general, construction of the transmitter is somewhat along the same lines as the receiver and employs the same ceramic terminal boards and resistor assembly. Likewise, ceramic tube socket bases are used in the transmitter. It is noticed that in the equipment all phenolic materials including bakelite, plastics, etc., are kept to an absolute minimum, wherever it would be desirable to use this type of material, ceramics are employed instead.

The power supply for the Messerschmitt 109 transmitter and receiver combination consists of a motor-generator unit and filter combination for both the output and input voltages; these are combined in one unit. The voltages supplied by this unit are: 12 volts DC for lighting the filaments of the tubes; 400 volts DC to supply the plate and screen voltages for the tubes; 275 volts 90 cycles AC, rectified at the transmitter, to supply the bias voltages for the oscillator and speech amplifier tubes.

The motor generator unit itself is designed to operate from a 24-volt DC source. Fuses for the high and low voltages both AC and DC are contained in this unit. The low voltage filter network is only for use in the primary side of the motor generator. The high voltage filter networks are for the receiver only, the transmitter filter being contained in the transmitter chassis itself.



The dynamotor, which appears to be greatly overweight

Top view of the receiver which could be designed a great deal smaller and still accomplish the same purpose

Other German Equipment

The Messerschmitt 109 radio apparatus by no means represents the latest radio equipment being used by the Germans. More modern designs and manufacturing practices have already made their appearance in this war, revealing the trend in the current restandardization of German aircraft radio apparatus.

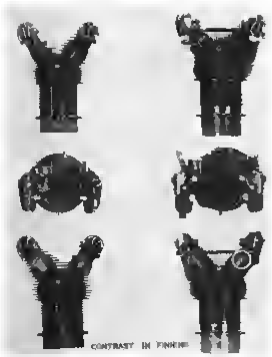
As an instance, some operational characteristics of recent Junkers aircraft radio apparatus may be cited. The transmitter operates in the 3 000–6 000 kilocycles range with about a 25-watt output, using a motor reel and a fixed antenna. The fixed antenna has a remote tuning unit controlled by a selsyn transmitter the rotation of which is controlled by an electromagnetic clutch. With power off, it is impossible to change the setting of the remote tuning unit, or to get it out of synchronization with the transmitter teletorque or autosyn or selsyn instrument. The receiver, operating in the same range, is good down to about ½ microvolt for 50 milliwatt output.

An interesting feature is the provision for resonating the airplane transmitter with the ground station transmitter, so that the ground station becomes the dominating or master frequency for all aircraft working that ground station. The same principle can be used for synchronization of transmitters and receivers in a given formation flight. It is a very simple and old idea: the master station is tuned in on the receiver, and then, through a switching arrangement, the airplane's transmitter is turned on and tuned until zero beat is obtained between the airplane's transmitter and the ground station transmitter.

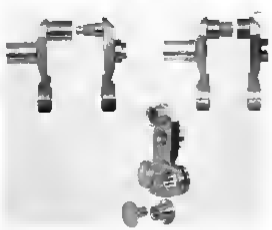
Numerous ingenious engineering innovations are apparent throughout the design, such as the clever use of Isolantite for terminal boards of fixed condensers.

Generally, despite some excellent pioneering work done in Germany in the past, such as the development of cermics for electrical and radio use, negative coefficient condensers, iron-core coils, and other familiar components, this country is indubitably far ahead of the best that Germany can offer in aircraft radio apparatus. Individual instances of our superiority could be cited, but their publication at this time may not be in the public interest.

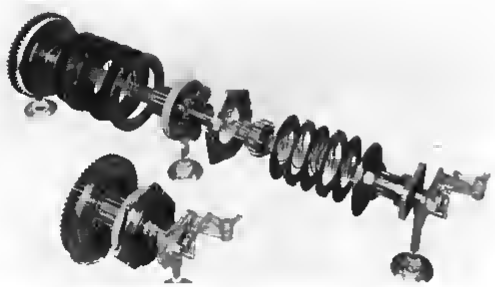
output without serious trouble, which placed it in a category substantially as reliable as most of the other engines of its day. Its principal weakness was the cylinder construction which was so light that the resulting deflection under pressure tended to crack the water jackets, and there was also considerable crankshaft "whip"—due to the fact that the engine was running within 200 r.p.m. of its major critical, which was hard on accessories and accessory gears. The fact that few of these engines were used in the war was due principally to the lack of airplanes suitable for them. The production of these engines was by our automobile industry which had some 10,000 engines built by the time of the Armistice in what



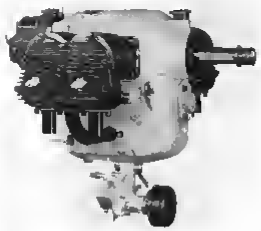
Comparison of cylinder finning. Three views at left show an early Pratt & Whitney; those at right a late P. & W. "Wasp".



Split crankshaft of a Pratt & Whitney engine. Earliest design is at the top left. Lower view shows the dynamic vibration absorber used in this engine.



The two-speed supercharger drive of a Wright Cyclone engine



A Continental Model A40 light plane engine of 1931. This was the first of many successful 4-cylinder opposed engines that are now in general use

constituted one of the major production achievements to date. It is especially interesting to remember that the automobile industry was willing to stop automobile production completely in order to devote its entire resources to the building of these engines. Contrasted with the present situation, the action of these companies in the last war is especially remarkable.

In the years which have intervened since 1916, the development of aircraft engines has been so wide-spread and so rapid that we will attempt to mention only those which constituted prototypes for subsequent important developments. Among the most important of these was the Lawrance 9-cylinder radial air-cooled engine developed in 1921-22 by a group of engineers under the supervision, and spurred by the enthusiasm, of Mr. Charles L. Lawrance. This engine was definitely the prototype for the modern American radial air-cooled engine. Rated at 200 hp. at 1800 r.p.m., it had cast-aluminum cylinders with steel liners, a cast-aluminum crankcase, and a crank and master-rod construction very similar in design to those of modern practice. Manufacture of this engine was soon taken over by the Wright Aeronautical Corporation, destined to become one of the major companies in the field chiefly by virtue of its acquisition of the Lawrance manufacturing rights. Under the guidance of the Wright Company the original Lawrance design was developed into the Wright J-5, a more rugged engine of about the same rated power. This was the first really reliable American air-cooled engine, a fact attested by its use in the famous flights of Lindbergh, Chamberlin, Byrd, and others. This engine used the present accepted type of cylinder construction, consisting of a steel barrel with integral cooling fins onto which was screwed a cast-aluminum cylinder head. This arrangement, originally developed by Dr. Gibson and Mr. S. D. Herron in England, was first given successful application in the English Armstrong-Siddley engines, but the Wright J-5 engine was the first in this country to use this construction in quantity production.

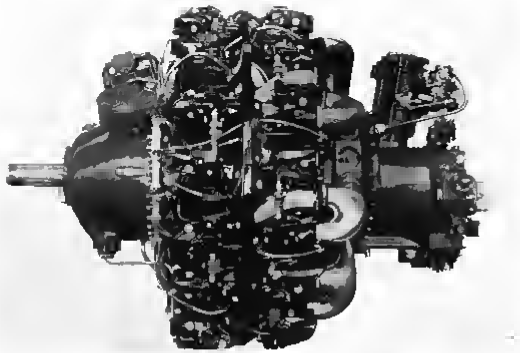
The next landmark in the air cooled field was the Pratt & Whitney "Wasp." Developed in 1926-27 by a group of engineers and technicians who branched off from the Wright Company to found the Hartford organization, it was notable because of its relatively high power rating for an air-cooled engine, namely 425 hp. In it were pioneered valve-rocker boxes cast integral with the cylinder head, the split crankshaft with one-piece master rod, and engine mounting lugs cast on the inlet manifold section. It also was the first production engine in this country to incorporate a gear-driven centrifugal supercharger.

The next significant step in air-cooled engine development in this country was the Wright Cyclone 1820-cubic-inch engine brought out in 1929. The progressive development of the engine since that date is shown in the accompanying graph. These curves can be taken as typical of the development of the

large American air cooled engines now in general use. It is given not so much for the figures applying to this particular engine as to show the rate at which engine development has been taking place in the last 10 or 12 years.

Next in the air-cooled field came the Pratt & Whitney Twin Wasp, the first successful two-row radial engine in this country, followed closely by the larger engines of this type recently developed by both Wright and Pratt & Whitney. These latter are admittedly the finest of their power rating at present available anywhere in the world.

In connection with the rapid development of the high-powered American air-cooled engine, the importance of service on the regular airlines of the United States should be mentioned with emphasis. This is a much more severe service than peace-time military operations, because it demands continuous running at high power for many hours a day, together with the lowest possible maintenance costs and the highest reliability. The commercial air lines of the United States have furnished a laboratory for the proving of high-powered aircraft engines which are far ahead of those available anywhere else in the world, and to these airlines must be given credit for an important part in the development of the modern American air cooled engine.



A Pratt & Whitney Double Wasp, which develops 2,000 hp

Wright Aeronautical reached new high in engine production for June when engines totalling 1,710,000 hp. were built. Gen. Arnold, shown here at right, with Guy Vaughan left, and M. B. Gordon, center, is reported well pleased with production

A liquid-cooled Allison in the "tear-down" department of the factory, after it has completed a test run.

European development of air-cooled engines proceeded simultaneously with that in the United States, but with one possible exception it has always lagged behind similar American developments. The exception is the engines developed by the English Bristol Company, which has pioneered single-sleeve valve air-cooled radial engines which are apparently taking an important part in the present war.

In the field of liquid-cooled engines it has already been noted that the French Hispana-Suiza pioneered the modern composite en-bloc construction. The next important step forward in this field was made by Curtiss with the 12-cylinder D-12 engine, put into production about 1923. The fundamental Hispana-Suiza construction was modified to give a 4-valve cylinder-head of excellent quality. The success of this engine in racing (Pulitzer Trophy and Schneider Cup) caused it to be copied in essential features by a number of European manufacturers. The liquid-cooled engines playing such an important part in the present war, [illegible] the Rolls-Royce, the Mercedes-Benz, the Junkers, and our own Allison [illegible] may safely be said to owe a great deal to the pioneering work of the Curtiss company with the D-12 and "Conqueror" engines.

Table I is an attempt to list engines which were reasonably large pro-

tures which have carried through to present modern practice.

An historical review of the airplane engine would not be complete without mention of the great contribution to present-day engine performance and reliability which has been made possible by improvement in fuel quality, particularly with regard to the anti-knock properties of aviation gasoline as measured by the octane number. Table II herewith shows the octane number of the best fuel generally available for aircraft during the past few years. This development has involved painstaking and expensive research on the part of the fuel refiners, and their contribution to aircraft engine output, economy, and reliability cannot be underestimated. Present fuels of 100 octane or better are synthetic products in which the crude petroleum has been almost completely transformed into a fluid eminently suited to modern high-performance combat engines.

While this article has been concerned chiefly with engines of high power output suitable for military and airline service, the concurrent development of so-called "light plane" engine should be mentioned. The origin of the present highly satisfactory horizontal-opposed engines of 4 and 6 cylinders should be credited to the Continental Aircraft Engine Company, who brought out their model A-40 in about 1930. It is interesting to note that all the successful American engines of under 100 hp. are now of this general type, and that the type is also beginning to be very important in the range between 100 and 200 hp.

At the birth of AVIATION in 1916, "trouble" was the word perhaps most often associated with the aircraft engine. In the ensuing years the progress of the aircraft engine from the operators' and pilots' point-of-view might be charted by the reduction in frequency of engine trouble, as well as by increases in size, performance, and economy. Perhaps the improvement in reliability which is characteristic of the modern aircraft engine as compared to its predecessor of 25 years ago is the most significant improvement of all. From the days when the forced landing was an integral part of every pilot's experience to the present time when few young aviators have ever experienced such an unhappy event, is a tribute to the skill and perseverance of the designers and builders of aircraft engines, together with those who supply the materials and the accessories, the fuel and the oil, which make the present reliable operation of aircraft power plants possible.

Table II

Year	Octane No. of Fuel in General Use by Airlines	Highest Octane Fuel Available
1925	73	73
1926	80	80
1928	87	87
1936	95	100
1937	90	100
1938-40	90	100+

Table I

Significant Aircraft Engines (1903-1939)

Being a list of engines which in reasonably large production for the time incorporated new features which have survived to the present day.

Name	Approx. year in production	Type	Take-off HP	Take-off RPM	Pioneer Features
Air-cooled engines					
Gnome monosoupape	1909	5 radial (rotary)	34	1300	Steel cylinders, steel crank case, one-piece master rod, split crankshaft
Lawrance J-1	1924	9-radial	200	1800	Cast-aluminum cylinder heads, internally cooled valves
Wright J-5	1927	9-radial	220	1800	Steel barrel aluminum head cylinder, enclosed valve gear
Pratt & Whitney "Wasp"	1927	9-radial	425	1800	Integral rocker boxes, pressure-lubricated valve gear-mounting lugs on manifold, gear-driven supercharger
Wright "Cyclone" 1820 (1000 — Oct. 1936)	1929	9-radial	550	1820	First 9-cylinder engine to reach 1000 h.p. dynamic vibration absorber, 2-speed supercharger, multi-piston reduction gear, baffled cylinders, sodium-cooled exhaust valves.
Pratt & Whitney "Twin Wasp Jr."	1932	14-radial	700	2500	First American doublerow radial in production
Continental A-40	1931	4-cyl.	37	2550	4-cylinder opposed light-plane engine
Liquid-cooled engines					
Mercedes	1915	Vert. 6	160	1400	Welded-steel built-up cylinders (now obsolete)
Hispano-Suiza	1915	V-8	150	1450	Composite en-bloc steel and aluminum cylinder construction
Hispano-Suiza	1916	V-8	200	2000	One of the first successful geared engines; first to mount a cannon firing through propeller shaft
Curtiss D-12	1922	V-12	440	2200	Composite en-bloc cylinders with 4 valves per cylinder
Rolls Royce Merlin	1935	V-12	1025	3000	First successful liquid-cooled engine rated above 1000 hp.
Mercedes Benz	1939	V 12 Inverted	1050	2400	Fluid-drive supercharger, inverted cylinders, fuel injection, spark ignition

Curtiss Trainer

(Continued from page 105)

The landing gear is retractable by means of a hydraulic system which is operated by an engine-driven pump providing instantaneous action without manual effort by the pilot. A hydraulic hand pump is provided for emergency operations, and a mechanical release is provided for the up-latch to supplement the normal hydraulic actuation. The landing gear hinges at a point under the main wing beam and folds back and up into the wing into a 'clam shell' type fairing. A landing gear position warning signal is provided.

Rudder and elevators are constructed of steel torque tubes and the horizontal stabilizer is of full cantilever, fixed type with multi-cellular construction. The fin is similar to the horizontal stabilizer in construction.

No information concerning performance and specification figures of the plane, or the number ordered by the Navy, has been announced. As to numbers, however, the St. Louis plant is proceeding to speed up its production of which the recent mass flight delivery is a sample of things to come.

Aviation Magazine

(Continued from page 77)

had the courage to keep the airports open during this long period of near-starvation were quick to respond to the idea. One of our early editorials was the 'Flying Service Decalogue."

1935— The operators wanted a place in which to exchange ideas. So we inaugurated the "Operators Corner" which has provided such a service.

1935— Merchandising methods were haphazard in the old days but the advent of low-priced aircraft opened the way for new and more effective methods. This new era was heralded by a series of articles by successful merchandisers. The first of these was "Tapping the Mass Market" by Al Bennett, who has since become one of the foremost airplane salesmen of the time.

1935— Airports that paid their own way were scarce in these days, but we succeeded in finding one and persuaded the operator to tell us how it was done. This was the beginning of our campaign for recreational facilities at airports. The article was "Hitch Your Airport to the Stars," the author, dynamic Major C. C. Mooseley.

1940— Even with war clouds threatening, there is still great interest in miniature aviation country clubs. Our recent article by William C. Strohmeier on how such a club can start modestly and grow has attracted much interest.

Naval Aviation

(Continued from page 58)

ciency. Capt. W. A. Moffett was appointed the first Chief of the Bureau with the rank of Rear Admiral.

In 1925 President Coolidge appointed the Morrow Board. The recommendations of this board resulted in the most important influence ever exerted on Naval aviation. As a result of these recommendations, Congress authorized in 1926 a five-year building program to include 1,000 service aircraft.

Through the years the number of aircraft carriers has increased. The U. S. S. Langley was commissioned a carrier in 1922. In 1925 both the Saratoga and the Lexington were launched. The Ranger was commissioned in 1934, the Yorktown in 1937, the Enterprise in 1938 and the Wasp in 1940. The Hornet, launched in 1940, will be commissioned in the very near future. Several carriers of the eleven recently authorized are in the process of construction.

The Navy ordered its first airship, a non-rigid, in 1915 but the prototype was too heavy and was soon dismantled. A "B" type was developed capable of a 12-hour flight and 16 such airships were delivered in 1917 and 1918. They were used for both training and coastal patrols. A "C" type was built and 10 such ships delivered before the Armistice. Several other types of non-rigids were developed, the current series being the K&L type.

The first of the rigid ships was the U. S. S. Shenandoah, commissioned in 1923. This ship was lost in a storm in 1925. In connection with a reparations agreement, the Los Angeles was built in Germany in 1924, flown to this country and turned over to the Navy. She was flown for eight years before she was retired, during which time she made many famous flights. The large American built rigid airship the Akron was delivered to the Navy in 1931. After 17 months of operations she was wrecked in a storm off the New Jersey coast with a loss of nearly all her crew, including Admiral W. A. Moffett, Chief of the Bureau of Aeronautics. This was a severe loss to the Navy. A sister ship, the Macon, was put into service in 1933. About two years later, while operating with the fleet in the Pacific, she was damaged and also sank but fortunately 82 of the crew of 84 were saved.

In recent years Naval aviation activities have been terrifically accelerated. Many phases of our program have progressed so much in recent years that lengthy articles would be needed to describe them. Formerly one might count the active air stations on the fingers of one hand. Now the Navy has a chain of air stations from Alaska to San Diego, another along the Atlantic coast, a third along our Southern borders and a fourth in the islands of the Pacific.

Our pilot and mechanic training facilities have been accelerated in recent years. The number of Naval Reserve Air Bases for pilot elimination training has been increased. We now have three large pilot training stations, Pensacola, Jacksonville and Corpus Christi and an advanced school at Miami. Mechanics by the hundreds are being trained at six centers.

The Navy's procurement program is going ahead rapidly and delivery of both training and combat planes is being timed to coordinate with actual need for the airplanes.

It is indeed a long way back to the Naval aviation of 1916 and much has happened in these 25 years. Some of us who saw the possibilities in aviation in those days and who believed it could be utilized for naval use have lived to see naval aviation grow steadily through the years. Today it is a bulwark of defense for our democracy.

Instruments

(Continued from page 234)

cover a wide variety of small ammeters, voltmeters, and thermometers of the resistance bridge circuit or thermo-electric type. Synchronous indicating systems take care of a variety of position indicators for wing flaps and landing gear. Pressure indicating instruments include vapor pressure thermometers, engine manifold, oil, and fuel. Then there are accelerometers to measure the increase or decrease in gravity during rough air or maneuvers, and clocks or chronometers with elapsed time setting and sweep second hands.

Radio apparatus has added to the space requirements of today. It is a subject in itself that we can only touch upon to say that it is vital to air navigation and blind landing systems that are now in the making.

The tremendous growth of instrumentation indicated in the last ten years has brought some relief to the pilot in the way of simplifying his task, first by substituting automatic operations for manual ones, and second by dividing some of his duties among his crew. This leaves the pilot with monitoring instruments to check, a light task which reminds us of that gag where one indicator among very many others is pointed to as the one that tells the pilot when all the others are working.

Window Shopping

Micro Switches—Catalog No. 60 containing characteristics, dimensions, prices and information as to application of all stock Micro Switches, plus additional information of special types. Micro Switch Corp., Freeport, Ill.

Metal Bellows—Bulletin No. 139 offering concise descriptions of Seamless Metal Bellows and Bellows assemblies. Illustrated with application diagrams. The Fulton Sylphon Co., Knoxville, Tenn.

Handbook on Metal Cutting—Suggestions and hints for proper selection and use of hand and power hack saw blades and flexible back hand saws outlined in 20 page booklet just issued. Clemson Bros., Inc., Middletown, N. Y.

Oakite News Service—Important part played in National Defense by proper cleaning for spot welding described in May-June issue. Oakite Products Inc., 22 Thames St., New York, N. Y.

Fractional Horsepower V-Belts—One-page catalog featuring tables on standard fractional horsepower V-belts. Section describes balanced construction of company's V-belt and advantages of V-drives. The B. F. Goodrich Co., Akron, Ohio.

Elastic Stop Nuts—Pamphlet on self locking stop nuts, how they work and why. Elastic Stop Nut Corp., 2330 Vauxhall Rd., Union, N. J.

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IT is well over two hours now since the ship's twin engines roared once again into life and the tarmac at Halfway airfield started slipping hurriedly away from the cabin windows. The Lawes River with its attendant pastures and creeks is just over one hour and two hundred miles behind us to the West and already the patchwork landscape ten thousand feet below is changing from wooded foothills into flat lush plain. Away now to the right the main coast arterial is slicing diagonally across country to join the broad traffic spattered ribbon of the State Highway beneath us. Soon they will dive together as one wide boulevard into the tangled environs of the City, and the great ship will start its wide down-spiral to the airport. Dates fixed for the half hour after the ship's arrival will be kept to time. Nothing uneventful has happened on this swift luxurious hop from capital to capital. Nothing uneventful was expected to happen. In modern travel we take full efficiency for granted.

But what **is** full efficiency? Certainly it is not—and never can be—100%. That is beyond the bounds of human attainment. But if we can attain 90 9%—then that is as near as human endeavour will ever get to perfection. **And is one of the hundred-and-one things which go to make aircraft efficiency this amazingly high percentage has been obtained. In Filtration.**

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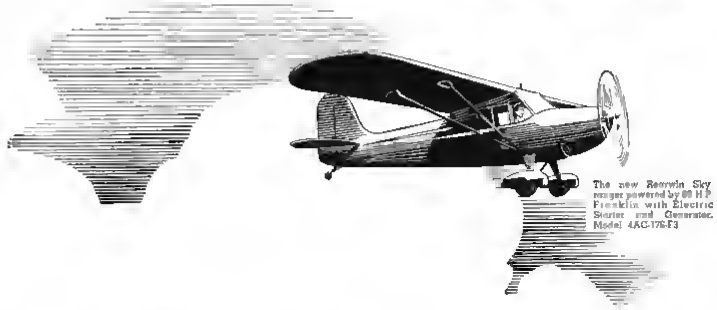

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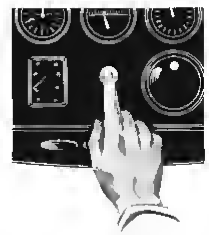

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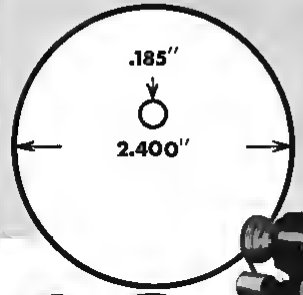

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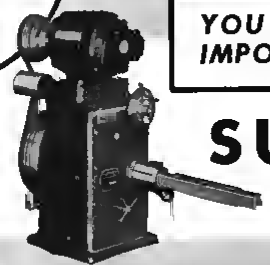

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Inner Bearing Ring "Accurately removes last 'tenth' of stock"

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy

Molded Composition (Bakelite) Pulleys. Molded composition is a difficult material to machine but it can be easily honed to a smooth finish.

Stone Lettering Arm Hammer. Sunnen honing does in few minutes what it took 20 minutes to do by lapping."

"Produced as extremely accurate and glasslike finish."

Diesel Engine Fuel Injector Cylinder. So accurate that a piston can be fit within .00025 inch."

"A perfectly straight round hole with a mirror finish"

Throughout the metal working industries, especially on defense jobs ranging from airplanes to steam turbines, hundreds of manufacturers have found the answer to increased production with greater accuracy and lower costs in this practical, inexpensive machine—because it:

1. Corrects errors of out-of-roundness and taper produced by previous operations
2. Produces super-smooth surface finishes
3. Finishes holes to close tolerances both as to size and straightness
4. Maintains alignment established by previous operation
5. Provides simple, low cost production method of duplicating sizes accurately

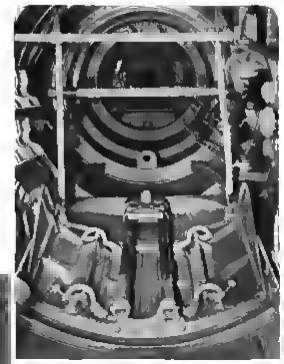
and here's the best news of all! You don't need a skilled machinist to operate the Sunnen Precision Honing Machine! Any intelligent workman with a few hours' practice can produce super-smooth finishes and hold accuracy within .0001".

Can be set up and work located in less than one minute!

If you have an internal sizing or finishing operation within the range of the Sunnen Precision Honing Machine it will pay you to write at once for new 8-page bulletin — or, if you prefer, a sales engineer will be glad to call and demonstrate in your plant on your job just what this machine can do for you.

SUNNEN PRODUCTS CO. 7942 Manchester Ave., St. Louis, Mo.
Canadian Factory, Chatham, Ontario

True Flight and "Happy Landings" for our *Flying Cadets*



SINEWS OF STEEL as trustworthy as modern engineering can make them control the vital tail assembly of this trainer —responding to the slightest touch by the pilot

MEET GOVERNMENT SPECIFICATIONS

American Tiger Brand Aircraft Strand and Cords are available in either Uncoated (as manufactured) or U.S.S. Stainless Steel in the following constructions:

19-wire Strand	semi-rigid
7 x 7 Cord	flexible
7 x 19 Cord	extra-flexible

USS

AMERICAN *Tiger Brand* AIRCRAFT STRAND AND CORDS

. . . their safety is guarded by sinews of the finest steel!

YOU'LL find American Tiger Brand Aircraft Strand and Cords in a large percentage of the planes that are rolling off the production lines these days—*for these very important reasons!* Only the finest steels—tested and retested many times—go into the manufacture of Tiger Brand Strand and Cords. Every wire of every cable is cold drawn to high-tensile strength through precision dies. Minimum stretch, high fatigue resistance and superior strength are in-built features. Every detail of their production is under the supervision of men who specialize in the making of control cables that are as sound and trustworthy as modern science and modern manufacturing equipment can make them.

American Tiger Brand Aircraft Strand and Cords meet, and safely exceed, all requirements of the latest U.S. Army and Navy specifications.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* United States Steel Export Company, New York

UNITED STATES STEEL

On The Tomahawk flown by the R.A.F. is the Curtiss Electric Propeller, built by The Propeller Division of The Curtiss-Wright Corporation, Caldwell, N. J. Of the electrically controllable pitch type suitable for both automatic constant speed and manual selective control. Provides "full feathering"

Curtiss Electric Propellers

SPEED DEFENSE WITH SKF

Like a hawk, poised ready for the kill, this Curtiss P-40 awaits the command that will send it hurtling through space at more than 350 miles an hour. The success of its mission, however, depends upon the reliable performance of all parts—particularly upon SKF Bearings on the Curtiss Electric Propeller and control surfaces. And SKF "comes through" as it has done since Aviation was in its infancy. Good bearings, good propellers, and good planes always go together. 4046

SKF INDUSTRIES, INC., PHILA., PA

SKF

BALL AND ROLLER BEARINGS

DON'T SPEND A NICKEL ON FLUORESCENT LIGHTING . . .

until you can answer YES to these Four Questions

1 *Am I getting the best lighting for my business, competently planned by lighting engineers?*

"How much light do I need? How much can I afford to spend and what results can I expect from this new light source?"

Don't guess. Ask your G-E lamp distributor. He has behind him all the engineering resources of General Electric. He can call in local G-E engineers, averaging 16 years experience with General Electric for help and advice so essential to the proper installation of fluorescent lighting. Your electric service company can also give you sound, up-to-the-minute help.

2 *Am I getting a sufficiently wide choice of fixtures so that I can select exactly the ones I need?*

"Have I looked over *enough* fixtures to be able to choose the ones that suit *me*? Am I getting fixtures on the basis of the amount of light I need, rather than on price alone?"

Ask General Electric! G-E makes no fixtures for MAZDA F lamps, but cooperates with leading fixture manufacturers to assure fluorescent units geared to your requirements. More than 100 different types of tested, certified, guaranteed fixtures are now available. Your G-E lamp distributor carries many of them. See his complete line!

3 *Am I getting Certified Fluorescent Fixtures for top-notch lighting and dependable operation?*

"Will my fixtures start quickly, work efficiently, stand up under long usage? How can I be sure?"

Insist on tested, *Certified* guaranteed fixtures such as those with Fleur-O-Lier label or industrial fixtures with RLM label. Fleur-O-Lier fixtures are tested and certified by Electrical Testing Laboratories to meet specifications set up by MAZDA lamp manufacturers. You get a complete, written Fleur-O-Lier manufacturer's guarantee; and fixtures, ballasts, and starters that help give full light for current consumed.

4 *Am I getting the right lamps — lamps that will give maximum light for current they consume?*

"Will the fluorescent lamps I buy give maximum light throughout life at low cost? Can I get the same high quality which has made G-E MAZDA incandescent lamps a standard of performance?"

You can if you specify G-E MAZDA F lamps! . . . lamps that must pass hundreds of tests set up by MAZDA research. As a result of continued improvements, today's G-E MAZDA F lamps cost as much as 52% less than when G-E produced the first practical fluorescent lamp. Yet they give up to 40% more light!

G.E. ANNOUNCES NEW LOW PRICES ON MAZDA F LAMPS

Effective August 1, 1941

14 watt T-12	was $1.05	NOW 90c
15-watt T-8	was .85c	NOW 75c
15 watt T-12	was $1.10	NOW 95c
20-watt T-12	was $1.10	NOW 95c
30 watt T-8	was $1.10	NOW 95c
40 watt T-12	was $1.60	NOW $1.35
100 watt T-17	was $3.50	NOW $3.00

Above prices refer to daylight and 3500° white.
Prices also reduced on soft white and warm red F lamps.

G-E MAZDA LAMPS

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MAIL THIS COUPON TODAY!

General Electric Company, Dept. 166 AV-H
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Please send me your new booklet, "Let Fluorescent Lighting Roll Back the Roof".

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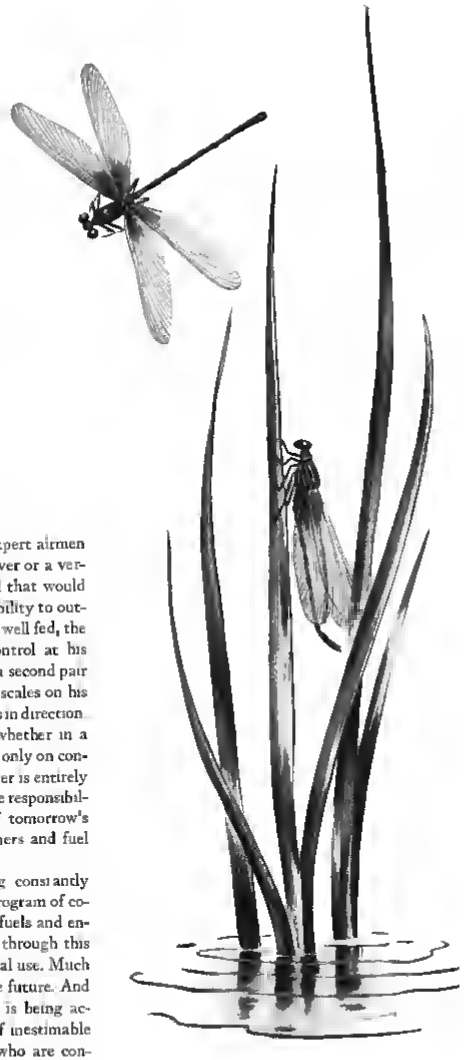
Address

City State



Control

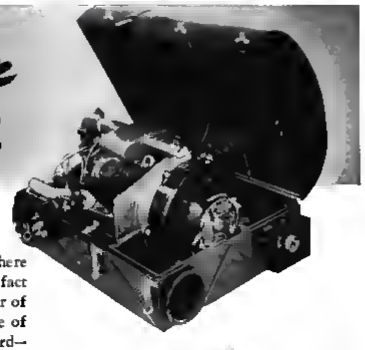
THE DRAGON FLY is one of the most expert airmen of the insect world—able to do a wing-over or a vertical reversement with an ease and skill that would be the envy of any pilot. Since it is his ability to outmaneuver smaller insects that keeps him well fed, the dragon fly employs every means of control at his command. Lacking tail surfaces, he uses a second pair of wings, a flexible body and adjustable scales on his wing surfaces to aid him in abrupt changes in direction.

However, superior air performance, whether in a dragon fly or in an airplane, depends not only on control, but on *power*. Because aviation power is entirely a matter of engines and fuels, much of the responsibility for improving the performance of tomorrow's planes must be shared by engine designers and fuel specialists.

Today, Ethyl engineers are working constantly with aviation technologists in a broad program of cooperative research which involves both fuels and engines. Much of the information gained through this research has already been put to practical use. Much more will undoubtedly be applied in the future. And the fund of data which is being accumulated may prove of inestimable value to the engineers who are constantly seeking to improve every phase of aviation.

ETHYL

Auxiliary Power
...IN A PACKAGE

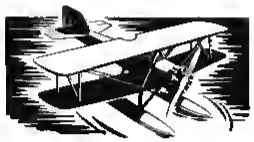


WHILE aircraft engine design has progressed to the point where giant planes have more than 8000 horsepower, the very fact of this increase has given rise to the need for aircraft power of another type entirely. Today, multi-engined planes, because of their size and complexity, require additional power inboard—lightweight, aircooled powerplants to generate electricity for auxiliary equipment. The first production engines of this type bear the name of Lawrance, just as did the forerunners of all of the radial, aircooled aircraft engines in this country today.

IT WAS 20 YEARS AGO that Charles L. Lawrance saw, in the heavy watercooled engines on display at the Paris Aviation Exposition, a challenge to engineering. Returning to America, he undertook the design of a fixed radial, aircooled engine. In his New York workshop, he soon produced a successful two-cylinder model of approximately 30 horsepower. These engines never flew, although 450 of them were built for the Army. They were used in small ground-skimming trainers

known as 'grass-cutters". But the success of the new engine type led the way for larger ones to follow, and in 1921, the first 9-cylinder radial, aircooled engine of 200 horsepower passed its 50-hour type test for the U. S. Navy. The following year, with a Lawrance-powered TR-1, the Navy won the Curtiss Marine Trophy.

These Lawrance "J-1" engines were the forerunners of the famous Wright Whirlwinds with which many endurance records and transoceanic flights of the late



20's were made. The Navy recognized the advantages of radial aircooled engines for their equipment and standardized on them. The new radials were applied commercially to crop-dusting, and soon appeared on early airlines. As greater horsepower became available, airplanes grew larger, faster, and their utility increased many fold.

Two years ago, the industry was presented with another challenge—that of supplying auxiliary power for large military and naval aircraft. The function of these auxiliaries is not to replace the main engine generators entirely; their value lies in their ability to operate independently of them to furnish power for numerous secondary flight accessories such as galley plates, light and heat systems, air compressors, main engine starters, bomb hoists, armament drives, and interplane phone and radio equipment.

Under the direction of Charles L. Lawrance, the Lawrance Engineering and Research Corporation produced an aircooled engine-generator unit which met Navy requirements. Its first application, however, was not in aircraft, but in the Elco Patrol Torpedo boats of the Navy's "Mosquito Fleet"—craft of exceptionally wide cruising range and sensational speeds. Simultaneously, production of the aircraft version was under way for service with the patrol bombers.

For reliable, attention-free performance, these two units incorporated automatic control features, providing continuous operation under all flight conditions within the load range. Their 15 horsepower engines operate a 28 volt DC generator at a continuous power output of 5 K.W. and five-minute peak load

capacity of 7½ K.W. at sea level. Standard power output at 20,000 ft. is 3 K.W.

Flight engineers, at their stations, have only to operate the starting switch to cut-in the units. The generator, containing its own starting winding, feeds the power to the voltage regulator to hold the voltage constant at 24 volts for the aircraft system.

At the modern Linden plant, day and night shifts are dedicated to the quantity production of these sturdy auxiliaries, which in their soundproofed compartments, provide "power in a package" for the expanding needs of America's first line of defense—the U. S. Navy.

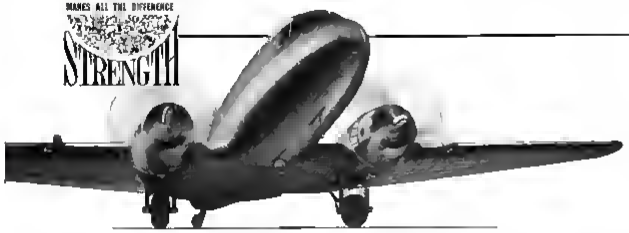
LAWRANCE Engineering and Research Corporation
LINDEN • NEW JERSEY

The Ceiling is Unlimited for

N-A-X
High Tensile

. . . the low alloy steel that has unusually high resistance to IMPACT, FATIGUE, SHOCKS and STRESSES

DUCTILITY
ITS INHERENTLY FINER GRAIN
MAKES ALL THE DIFFERENCE
IN
STRENGTH



For parts or products that must operate at top efficiency at extremely hot or at sub-zero temperatures, that must be light without sacrificing strength, N-A-X HIGH TENSILE *is the ideal low alloy steel*—a steel that is readily available and one that can be fabricated easily, usually without change in regular shop practice.

N-A-X HIGH TENSILE has other important features, too, which make it particularly adapted for aviation and automobile parts and products.

FABRICATION—N-A-X HIGH TENSILE can be formed readily, either hot or cold, with all the ease and speed of mild carbon steel—it goes through each phase of manufacturing smoothly, easily, quickly and economically. Its superior ductility permits cold drawing into intricate as well as simple shapes. And because of its extremely high ductility, finished products and parts have unusually high resistance to IMPACT and FATIGUE, at very hot or sub-zero temperatures. It possesses excellent welding properties and has good resistance to both corrosion and abrasion.

Complete information will be given if you will wire, telephone or write for a Great Lakes engineer. He will also show you how you can use N-A-X HIGH TENSILE to advantage.

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Hot Rolled Strip (down to 1 inch wide) . . . Hot Rolled Strip Sheets (up to 91 inches wide) . . . Spring Steel (carbon and alloy) . . . Merchant Bars . . . Forging Bars . . . Automobile Bumper Sections . . . Bar Mill Sections . . . N-A-X HIGH TENSILE Bars, Shapes, Sheets, Billets . . . Sheet Bars . . . Hot and Cold Rolled Sheets . . . Michigan Metal for Vitreous Enameling . . . Deep Drawing Quality (in all grades, widths up to 91 inches) . . . Stran-Steel Metal Framing for Residential and Commercial Construction.

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Executive Offices, Pittsburgh, Pa.

Upstairs
Pressure is the Problem

AND AIRESEARCH HAS THE ANSWER *Now!*

U. S. Patent No. 2201554

1941 MODEL of the Only Type Cabin Pressure Control Valve Test Flown and Laboratory Proven

The Stratoliner is the proving ground of a new era for military and commercial aviation . . . an Era of Flight promising scarcely dreamed-of strategic and economic potentialities. Aviation's progress into the "upper levels" has presented problem in Airesearch's specialized field.

Ultimate solution to the basic sub-stratosphere pressure problem is offered in Airesearch's new Cabin Pressure Control Valve. The prototype of this valve has been test flown, proven and brought to its present advanced state of development in the "Strato-Lab" at Airesearch's new 6,000 square feet laboratory.

The engineering principles and design refinements incorporated in this valve are being adapted for installation in single seater fighters as well as multi-place aircraft. Airesearch, now in its own newly completed 80,000 square feet plant is prepared for all out volume production of this vital valve. Engineering inquiries are invited.

AIRESEARCH MANUFACTURING CO.

New Offices and Plant at the Los Angeles Airport, Sepulveda Blvd., at Century, Inglewood, California

OIL COOLERS INTERCOOLERS CABIN PRESSURE CONTROL SYSTEMS

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HEAT TREATING EQUIPMENT FOR THE AIRCRAFT INDUSTRY

Special Design Annealing and Heat Treating Basket for use in the Aircraft Industry Adjustable shelves and sides. Six feet in diameter and six feet high

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AVIATION SUPPLIES

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When *your* plane needs service use Pacific Airmotive complete maintenance and overhaul facilities at Oakland or Burbank For 12 years Pacific Airmotive has met the exacting requirements of major airlines, government agencies and private flyers and will duplicate these standards for you.

NEW GARDEN CITY ENGINE OVERHAUL STATION TO BE OPENED SOON

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It's mighty good to know their ignition is up to *Highest Standards*

ALWAYS an inspiring sight, the view of planes over America takes on new significance today. For as the arm of America's air defense grows daily stronger, the sight of American-built aircraft overhead is comforting as well as inspiring

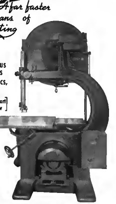
And it's good to know that our planes are up to the world's highest aviation standards Skilled craftsmen together with many years of service to every branch of American aviation enables Bendix-Scintilla to manufacture aircraft magnetos, spark plugs, switches and radio shielding that measure up to those high standards.

SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK

Tannewitz HIGH SPEED BAND SAWS

A far faster means of cutting

SHEET STEEL
NON-FERROUS METALS
PLASTICS, ETC.
[See Chart Below]



These superb machines, built to deliver any speed up to two miles of saw blade travel per minute without vibration, are doing hundreds of metal-cutting and other jobs in a fraction of the time previously required, in plants throughout the aviation industry. To increase production and make important savings in costs by all means investigate them, at once. A line requesting Metal Cutting Band Saw Bulletin will bring you the complete facts promptly.

PERFECTLY SAFE: Two-Wheel Lockheed Hydraulic Brakes automatically and instantly stop the wheels in case of saw blade breakage—completely guarded.

MANY HIGHLY DEVELOPED, PATENTED FEATURES found in no other band saws are incorporated in TANNEWITZ HIGH SPEED BAND SAWS.

Built by Sawing Machinery Specialists

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.

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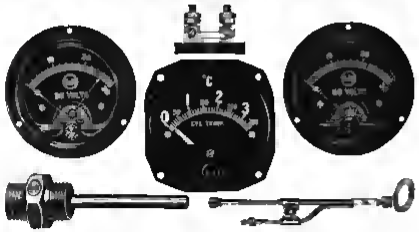
or something you don't want that other readers of this paper can supply—or use—advertise it in

Aviation's Market Place
AVIATION "CLASSIFIED"

DeJur-Amsco
AIRCRAFT POWER PLANT *Instruments*



NOW A NEW DESIGN in cylinder head thermometers with higher circuit resistance and greater torque than heretofore available . . . EASILY SERVICED and of rugged design with a minimum of parts . . . NEW CASE DESIGN permits mounting front or rear of panel without changing existing diameter of hole and mounting screw dimensions for existing instrument panel layouts also facilitates glass replacement without special tools and cements.

All DeJur aircraft products are made to conform to government specifications.

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DeJur-Amsco Corporation — Shelton, Connecticut

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Wrinkles or other imperfections in drop hammer stamped sheet structures disappear like magic. Powered with compressed air. Delivers 4,800 to 8,000 feather strokes or blows heavy enough to planish 18-gauge steel per urbuilt. This rapid succession of blows produces a finish so smooth as to be difficult to duplicate. Rivets to 3/8" can also be set cold with this.

SEIDEN PLANISHING HAMMER

Power and speed adjustments provide easy operation and positive control. Hammer and die support brackets adjustable to height to permit back straight or permit operation from sitting position. Rigid construction and solidness throughout eliminate operator fatigue and loosen noise. Large throat and ample spacing between dies permit handling wide variety of sizes and shapes. Rigid interchangeable planishing dies are furnished as standard equipment with each hammer. Get complete details at once.

Write today for information on this and larger models and smaller portable SEIDEN PNEUMATIC Hammers.

SEIDEN PNEUMATIC TOOL CO
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Designed and built for light aircraft by experienced aeronautical engineers, Champion Generators give long trouble-free service. Streamlined metal used for lightest weight, all iron and brass parts cadmium plated, adjustable pole shoe for blades, assembled with electro-graphited brushes and ball bearings, balanced propeller, easily installed. Guaranteed for one year against defective workmanship or material.

★ No More Battery Recharging
★ No More Light Failures
WIND-DRIVEN GENERATORS
★ Light ★ Strong ★ Air Cooled
★ Voltage Controlled ★ Low Priced

	Model No.	Amperage	Weight	Rotating Stop Dia. Diameter	Overall	
SIX VOLTS	W66	6	6	3¼"	10"	$25.00
	W612	12	9	3⅝"	12"	35.00
	W620	20	13	4⅛"	14	45.00
TWELVE VOLTS	W124	4	6	3¼"	10"	$25.00
	W128	8	9	3⅝"	12"	35.00
	W1215	15	13	4⅛"	14"	45.00

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Prompt Shipment from 10 Strategically-Located Steel-Service Plants.—Principal products include—Alloy Steels, Tool Steels, Stainless Steel, Hot Rolled Bars, Hoops and Bands, Beams and Heavy Structurals, Channels, Angles, Tees and Zees, Plates, Sheets, Cold Finished Shafting and Screw Stock, Strip Steel, Flat Wire, Boiler Tubes and Fittings, Mechanical Tubing, Rivets, Bolts, Nuts, Washers, etc. Write for Stock List. Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Detroit, Buffalo, Cincinnati, Cleveland, Boston, Philadelphia, Jersey City.

FOR quicker deliveries on cable terminals, junction boxes, conduit fittings, large stampings, special tool and die work.

★★★ Production has been raised to over one half million parts per month—and will soon reach the three-quarter million mark.

★★★ 400-ton hydraulic press permits high speed production of all type stampings.

Inquiries Invited

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2665 LEONIS BLVD. ★ VERNON, CALIF.

Serving the **AIRCRAFT INDUSTRY**

Unusual Lightness in Weight . . One-Half that of Aluminum

PHENOLITE Laminated BAKELITE
Obtainable in sheets, rods, tubes and special shapes. 12 Basic Grades and many sub-divisions to meet special uses.

NATIONAL VULCANIZED FIBRE
Tough, horn-like material which has great mechanical strength, excellent electrical properties.

NATIONAL VULCANIZED FIBRE COMPANY
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AVIATION'S MARKET PLACE

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BIRD Kinner K-5 Bird, completely reconditioned excellent throughout—$800.00 Becker Aircraft Supply Co., Pittsburgh Bettis Airport Box 988 Pittsburgh Penna

Cub

CUB TRAINER, J 3 Franklin 50, late 39. Licensed to November 41. Dual ignition. Steerable tailwheel, compass. Never damaged, extra clean. $850.00. No trade. Kerrville Flying Service, Kerrville, Texas.

Culver

CULVER DART—Ken Royce 90. New 1940. 230 hours total. Perfect shape. Sacrifice $1580 for immediate sale. Walt Paull 1514 E 65th St., Seattle, Wash.

Luscombe

LUSCOMBE—Phantom—Super Scarab 145 H P Warner motor never cracked up. 500 hours, just relicensed with complete plane and engine major overhaul at Pacific Airmotive California. Brand new two way Air Guide Radio, Kitcher compass, new tires directional gyro—complete instruments in perfect condition. Better than when new! Net $2800 cash will deliver it desired after payment write or wire. FS 682, Aviation 330 West 42nd St., New York N Y.

Porterfield

THIS BANK is liquidating property of The Mitchell Flying Service, including one $1,695 50 H P Continental Porterfield De luxe Model Plane total hours 1,030 with factory major overhaul at 904 and one $1,715 65 H P Lycoming Porterfield with dual ignition and dual brakes, 720 hours. Both licensed and in prime condition. Wire or mail offer to Commercial Trust & Savings Bank, Mitchell, South Dakota.

Stinson

1935 STINSON SR damaged in landing $550. Sewanee School of Aeronautics, Inc., Manchester, Tenn.

Waco

WACO YDC 1, 5 place custom cabin, 285 Jacobs. Total time 315 hours, excellent condition throughout, radio receiver, landing lights, flares, Curtiss Reed propeller, pants, ambulance equipment 55 gallon tank, cruises 165 mph. Sell or trade for Fairchild 24. Ernst Ruffini, General Delivery, San Angelo, Texas. (T)

Used Planes—General

(See Index on this page)
(See also Group Classifications)

1940 LYCOMING dual ignition, 55 H P Cub Trainer, majored 1940 Continental 65 H P Cub coupe, little time. Dart Low wing Ken Royce 90 H P majored clean 1939 Aeronca 90 H P Continental side by side controls. Waco YKC Cabin 5 place 225 H P modernized Jacobs engine. Will trade, will finance, will deliver. Phone Carrick 3283 or write E Lovejoy, 346 Overbrook Blvd, Pittsburgh. (T) No. 1

STINSON SM8A, new wing covering, engine magnefluxed, just majored, new battery, wind charger, complete instruments and radio. Today's best buy. 1937 Taylorcraft parts Continental 40 engine. Cub fuselage and parts also airworthy parachute. Boyer School, Cleveland, Ohio. No. 2

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AVIATION "Classified" — August, 1941

Undisplayed ads offering only ONE make of plane are grouped under that make. Others appear under "USED PLANES—General" and are numbered and indexed to enable readers to conveniently locate the makes of planes offered, or other items of interest. All other undisplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered or referred to by number, and indexed for the reader's convenience in quickly finding ads

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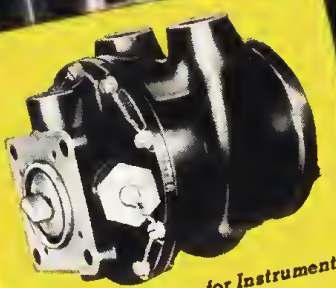

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